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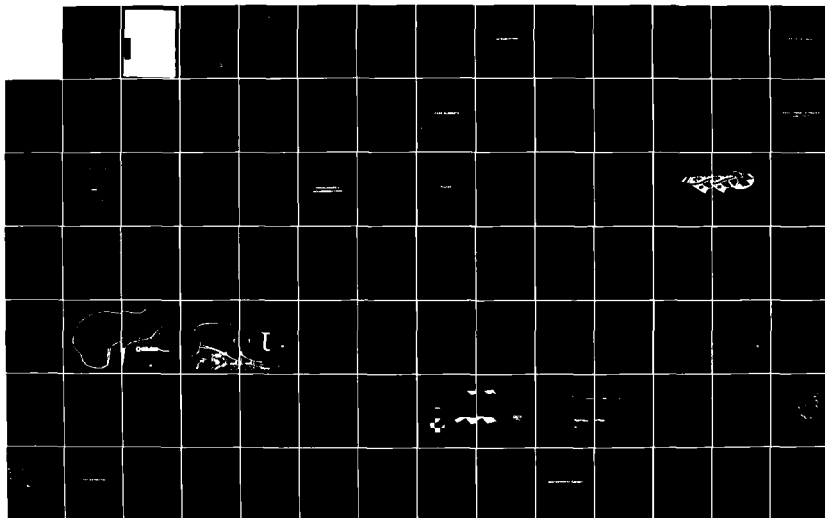
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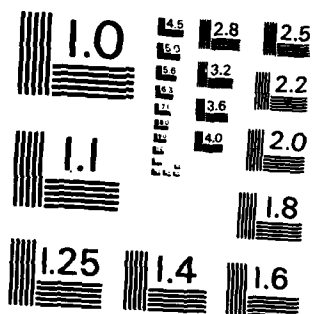
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**TUCSON DIVERSION CHANNEL  
DESIGN MEMORANDUM NO. 3  
FEATURE DESIGN MEMORANDUM  
PHASE I SPORT FIELDS & PICNIC AREA**

**APRIL 1983**

**US ARMY CORPS  
OF ENGINEERS  
LOS ANGELES DISTRICT**

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  Tucson Diversion Channel Recreation Development provides recreation and support facilities in the Tucson Detention Basin. The basin is a unit of the existing Tucson Diversion Channel Flood Control project. This document presents a coordinated development plan for all project resources and provide a basin for the next stage of design.		

## TABLE OF CONTENTS

	<u>Page</u>
Project Authorization	v
1. Introduction	1
2. Design Criteria	5
Grading	5
Low-flow channel design	6
Signage	7
Planting	8
Irrigation	9
Electrical	10
3. Park Elements	13
Parking Lots and Park Access	13
Picnic Area	13
Sport Fields and Courts	16
Nature Area and Hike and Bike Trail	16
Fitness Course	17
Archery Range	17
Bicycle Motocross	17
4. Phase I Development Schedule and Costs	19
Schedule of Development	19
Cost Estimates	19
Discussion of Cost Increases	21
Project Operation and Maintenance Requirements	22
5. Conclusions and Recommendations	25
 Figures	
Figure 1 - Cross Section through Basin	2
Figure 2 - Filling Frequency Chart	2
Figure 3 - Development Schedule	20
 Tables	
Table 1 - Cost Summary	21
Table 2 - Master Plan and FDM Cost Comparison	22
Table 3 - Estimated Annual Operation and Maintenance Costs	23
 Appendix A - Plates	
<u>Plate Number</u>	<u>Title</u>
1	Site Horizontal Control
2	Site Sketch
3	Site Plan

## TABLE OF CONTENTS (Continued)

Plates (Continued)		<u>Page</u>
4	Site Grading	
5	Cross Sections & Site Details	
6	Cross Sections & Site Details	
7	Cross Sections & Site Details	
8	Cross Sections & Site Details (Borrow Area 1)	
9	Cross Sections & Site Details (Borrow Area 2)	
10	Grading (Picnic Area)	
11	Grading (Fields & Picnic Area)	
12	Grading (Archery/Motocross)	
13	Site Planting	
14	Site Plan (Picnic Area)	
15	Site Plan (Fields & Picnic Area)	
16	Site Plan (Archery/Motocross)	
17	Site Irrigation & Domestic Water	
18	Sewer	
19	Electrical	
20	Restrooms	
21	Ramadas	
22	Fitness Trail Detail & Entry Sign	
23	Signage, Park Furniture	
24	Tot Lot	

### Appendix B - Itemized Cost Tables

Sport Fields	B-1
Picnic Area	B-2
Hike/Bike Trail	B-4
Archery/Motocross Facility	B-5
Fitness Trail	B-6
Low-Flow Channel	B-7

### Appendix C - Geotechnical Report

## PROJECT AUTHORIZATION

The Tucson Diversion Channel project was authorized by Public Law 80-858, approved 30 June 1948. Pursuant to a resolution of the Committee on Public Works of the United States Senate, dated 17 March 1955, the plan was modified, as detailed in a review report dated 20 January 1959. Construction of the flood control project was initiated on 16 April 1963 and completed on 12 April 1966 at a cost of \$6,158,989. The detention basin is one element of the Tucson Diversion Channel project; the basin consists of a 120-acre area enclosed by a 20-foot high levee, with an inlet structure in the northeast and an outlet structure in the southwest portion of the levee. The project was transferred to the Board of Supervisors of Pima County, Arizona, for operation and maintenance on 11 August 1966.

The Flood Control Act of 1944 (Public Law 78-534), as amended, authorizes the Corps to construct, maintain, and operate public park and recreation facilities at water resource development projects. The law also permits the Corps of Engineers to authorize local interests to construct, maintain, and operate recreation facilities. Under the Code 710 program, as outlined in EC 11-2-127, dated 15 April 1977, Federal funding is available for recreation facilities at completed Corps projects, provided local agencies furnish 50 percent of the development costs.

A master plan for recreation development of the Tucson Diversion Channel has been completed. This report investigates dry land and water based recreation within the detention basin limits which are complementary to the original project purpose of flood control.

The proposed recreation development project will be built on county-owned lands initially acquired for flood control. A cost-sharing agreement will be established whereby, before construction, Pima County will pay 50 percent of the cost shareable recreation development expenses and 100 percent of the non-cost shareable development expenses. The county will also assume all operation, maintenance and replacement responsibilities on project completion.



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# **INTRODUCTION**

## 1. INTRODUCTION

1.01 This report is the Feature Design Memorandum (FDM). Its purpose is to analyze the elements of the approved Master Plan in terms of specific sizes, materials, construction methods, location, and costs, and to develop this information to the degree necessary to proceed without further study to the preparation of contract documents, working drawings and specifications. This FDM was prepared by Myrick-Newman-Dahlberg & Partners, Inc., under contract No. DACW09-81-C-0021 for the Los Angeles District of the U.S. Army Corps of Engineers.

1.02 The project for which the Master Plan and this FDM have been prepared is the construction of a park within the detention basin portion of an existing flood control project in southeast Tucson, Pima County, Arizona. Completed in 1966, this flood control project protects developed areas in the City of Tucson and residential areas along Julian Wash against flooding. The site for the park is a 120-acre detention basin surrounded by dikes that are 20 feet high. This basin provides sufficient detention capacity to reduce the standard project flood from an inflow peak of 15,300 cubic feet per second ( $\text{ft}^3/\text{s}$ ) to an outflow peak of 9,300  $\text{ft}^3/\text{s}$ . Total design storage capacity is 1800 acre-feet. Flood water enters the basin from the east through the inlet structure at elevation 2506.3 and is discharged at the southwest through the outlet structure at elevation 2506.2. The basin can drain its capacity of water in one day.

1.03 While the FDM is concerned with the development of the park, it is important to view its recommendations with a clear understanding of the flood control aspect of the site. The cross-section (Fig. 1) shows schematically the way in which upstream surface runoff enters the basin, ponds within the basin, and is discharged at the downstream outlet.

1.04 The active recreation facilities are essentially above the 7-10 year flood level. It is possible for the playing fields to be inundated on the order of once every 7-10 years. This should cause no appreciable damage. The structures, picnic areas, parking, etc., are above any foreseeable flood level (Standard Project Flood Elevation 2,523) (Fig 2).

1.05 The combining of the flood control basin and recreation facilities has both positive and negative aspects. The most obvious benefit is the use of land for multiple purposes. While the flooding potential inhibits intensive development of parts of the area, the configuration of the site itself encourages above-normal plant growth, and provides a topography which in most respects enhances the park function.

1.06 During the 15 years in which the basin has been unused, a strong pattern of native growth has become established. Much of this plant community will remain, and be encouraged by the park development. This aspect is discussed in detail in the body of the report.

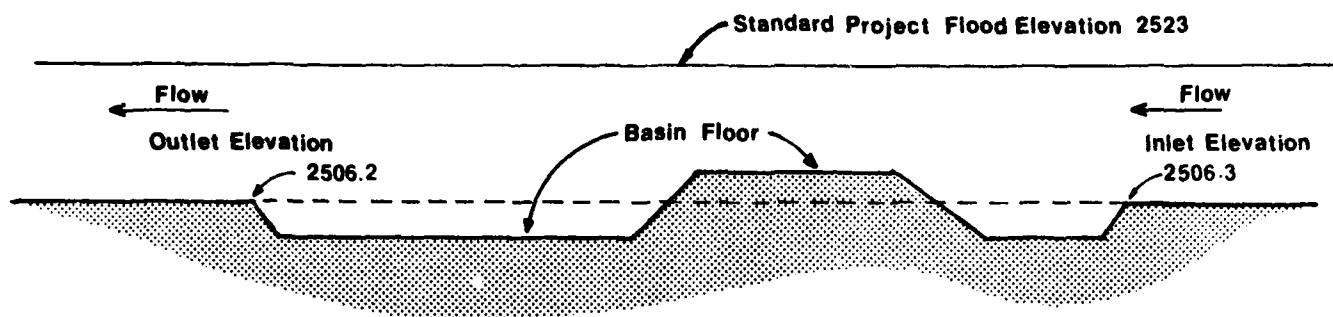


Figure 1 CROSS-SECTION THROUGH BASIN

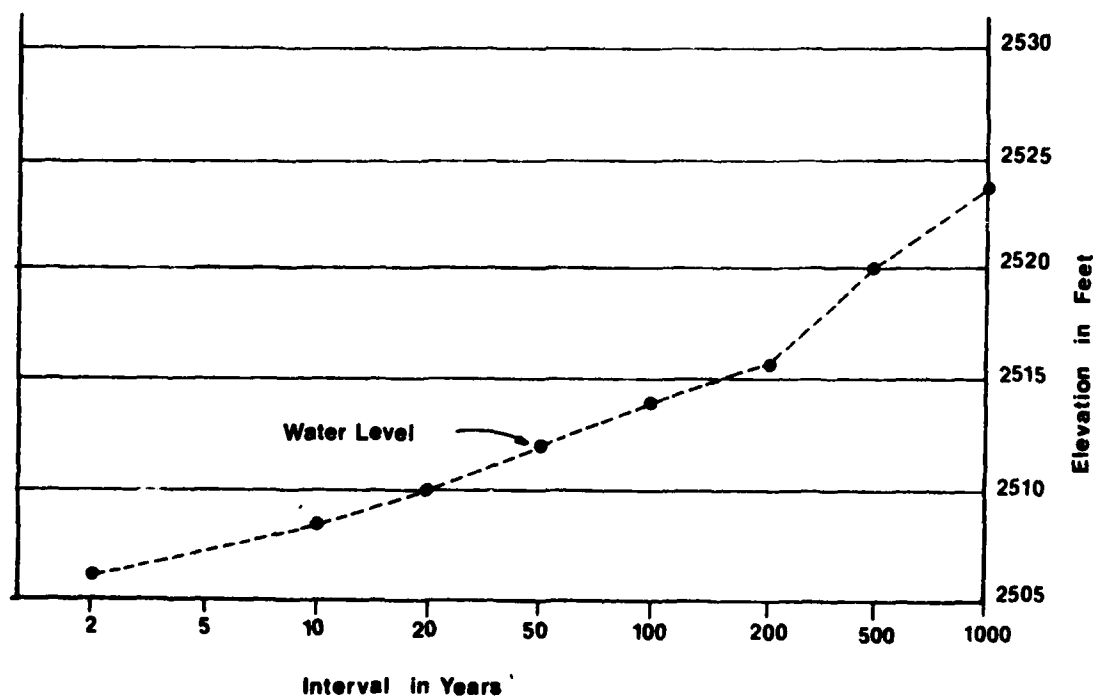


Figure 2 FILLING FREQUENCY CHART

1.07 The site configuration could potentially inhibit use of the park by handicapped persons; this possibility has been specifically addressed in the detailed design of the park facilities. Picnic areas, ramadas, rest rooms, etc., are all located at street level, which not only encourages their use by handicapped individuals, but also makes at least some of the park elements visible from surrounding areas. More specific provisions are discussed in the presentation of individual elements.

1.08 In addition to the design determinants for the various recreation facilities, particular attention has been paid to the practical considerations of maintenance costs in a desert environment, the appropriateness of structural elements to the traditions and attitudes of this area of the Southwest, and the inhibition of damage through vandalism.

1.09 Finally, the matter of water use and conservation is one of great importance in a community which depends upon a finite and dwindling ground water supply. The FDM has attempted to make all possible use of detained surface runoff, and to limit irrigation to those areas which are essential to the park function.

1.10 An Environmental Assessment of the recreation plan for the detention basin was prepared and included in the Master Plan. This assessment describes the existing physical conditions of the site and analyzes future impacts to the site and surroundings due to this development. The assessment concludes that no significant impacts to the quality of the human and physical environment will result from the development of this project.

1.11 The design and planning of the Tucson Detention Basin recreation area comprise a series of documents which, to date, include the following:

1. Design Memorandum No. 1, General Design Memorandum for Tucson Diversion Channel, Tucson, Arizona; November 1962; U.S. Army Corps of Engineers.
2. Final Report, Ajo Way Detention Basin Wet Park Feasibility Design Study; January 1976; Cella, Barr, Evans and Associates, Tucson, Arizona.
3. Feasibility Study; Proposed Wet Park at the Tucson Detention Basin, Pima County, Arizona; November, 1979; RGA Consulting Engineers.
4. Tucson Diversion Channel, Design Memorandum No. 2, Recreation Development Program, Master Plan, October 1981; U.S. Army Corps of Engineers, Los Angeles District Office.

1.12 The following guidance was used in the preparation of this feature design memorandum:

1. EM 1110-2-400, "Engineering and Design: Recreation Planning and Design Criteria." September 1971.
2. "Standards for Drafting" U.S. Army Corps of Engineers, June 1979.
3. "Instructions for Preparation of Cost Estimates" U.S. Army Corps of Engineers, May 1978.
4. ER 1110-2-1150, "Engineering and Design: Post-Authorization Studies." October 1971.
5. EM 1110-1-103, "Design for the Physically Handicapped," October 1976.

# **DESIGN CRITERIA**

## 2. DESIGN CRITERIA

### GRADING

2.01 Earthwork in the recreation area is designed to establish the various park functions without reducing the project's capability to provide flood control. The earthwork will achieve a balance of cut and fill within the detention basin. Where sport fields and the fitness trail are raised to minimize flooding, the necessary fill will be obtained from borrow areas in a manner which maintains the detention basin capacity and provides the necessary gradient for the low-flow channel.

Grading design is based on the following criteria:

1. Sport fields minimum elevation, 2507.5 (based on 7-10 year frequency flooding).
2. Detention basin outlet elevation, 2506.2.
3. Standard Project Flood elevation, 2523.
4. Invert elevation of existing manhole in 15" sewer in Ajo Way, 2514.81.

2.02 In order to minimize flooding damage the sport fields will be raised to a minimum elevation of 2507.5, which is the level of floodwater in the basin at a 7-10 year frequency. Since the majority of the basin lies below the outlet elevation (2506.2), approximately 100,000 cubic yards of fill will be required to elevate the sport fields. Fill cannot be imported from off-site locations. Further restrictions are set by the existing outlet elevation (2506.2) in that fill borrowed from areas which lie below this elevation can only be used to fill up to that elevation (See Fig. 1, p. 2).

2.03 Fill required to raise the sport fields to elevation 2507.5 will be drawn from two separate borrow areas: borrow area 1, which lies above the outlet elevation, and borrow area 2, which lies below the outlet elevation. Fill required to raise the sport fields to elevation 2506.2 will be borrowed from borrow area 2 (see pl. 4). The majority of required fill will be drawn from this area, resulting in a 4-foot deep borrow area at the southwest end of the basin. Fill required to raise the sport fields above elevation 2506.2 to elevation 2507.5 and above (see pl. 4) must be borrowed from an area which contains available fill material between elevations 2506.2 and 2523, the basin limit or standard project flood elevation. Borrow area 1 meets the above criteria and contains adequate quantities of fill material to achieve the fill requirement. Borrow area 1 represents a high point on the basin floor. The result of the earthwork will not be a borrow pit but rather a flat area consistent with the surrounding topography.

2.04 Some regrading of existing slopes in the eastern portion of the basin will be required. This will provide access from the picnic area to the sport fields; however, excess cut material which is drawn from elevations above 2523 will be disposed of at the disposal area (see pl. 4) which is on Pima County property and has been designated for this purpose.

2.05 The elevation of the nearest available sewer in Ajo Way (see pl. 18) has determined the minimum finish floor elevation for restrooms and other facilities requiring sewer connections. In all cases, these minimum floor elevations are above the standard project flood elevation of 2523. Fill is required to raise them to that elevation. Equal quantities of earth must be removed from the basin and disposed of at the disposal area in cases where the restroom or other future facilities are within the basin's limits.

2.06 Fine grading of the existing terrain will be required in the picnic area, parking lots, and for the bicycle motocross to create jumps and obstacles necessary for the sport.

The following quantities represent the grading strategy explained above (see pls. 4, 7, 8 & 9).

Total fill required	106,428 cy
Total fill required below 2506.2	74,815 cy
Total fill required above 2506.2	31,613 cy
Available cut between 2506.2-2523	18,331 cy
Borrow material required area 2	74,815 cy
Borrow material required area 1	13,282 cy

2.07 Borrow area 2 will quickly revegetate itself due to the abundance of existing Baccharis sarothroides, a prolific disturbance shrub, and water from the low-flow channel. Ponding in borrow area 2 will be a minimal nuisance because of percolation, high evaporation rates and infrequency of storms. Borrow area 1 will revegetate quickly for the same reasons stated for borrow area 2; however, the rate will be somewhat slower because of the difference in amounts of water reaching each area.

#### **LOW-FLOW CHANNEL DESIGN**

2.08 The low-flow channel that will be constructed through the Tucson Detention Basin is designed to carry flows of up to 300 cfs, which are expected to occur annually. The channel is 40 feet wide at the top with 3:1 side slopes and is approximately 3 feet in depth. Since the majority of the basin is lower in elevation than the outlet, a feasible design for the low-flow channel to flow directly from inlet to outlet cannot be accomplished as recommended in the Tucson Diversion Channel Master Plan. Therefore, the low-flow channel will carry the flow from the basin inlet to a point southwest of the hike-bike trail (see pl. 4) and discharge it into borrow area 2. Small discharges will evaporate or



percolate from the borrow area. Retained flow will not discharge from the basin until the height of ponding exceeds the outlet elevation of 2506.2. The resultant ponding will inundate the majority of the basin.

2.09 The purpose of the low-flow channel is to remove nuisance water due to occasional storms and irrigation from the high-use areas of the park. The channel is designed to take on the appearance of a natural desert watercourse. It will have no bank protection except at the inlet where water from heavy storms could endanger the sport fields and fitness trail. At this point, the south bank of the low-flow channel is protected with grouted rip-rap (see pls. 12 & 16). To achieve the appearance of hand placed grouted rip-rap, the grout will be brushed to expose the upper 1 to 1-1/2 inches of stone and allowed to set for not less than 1 hour. Air combined with water from a hand held nozzle would then be used to clean the exposed stone without damaging the surrounding grouted surface. The remainder of the channel's banks will be unprotected to allow the flow to naturally form the desired irregularities typical of desert watercourses. Natural revegetation by existing Baccharis sarothroides (desert broom) is anticipated. Additional plantings of native trees are provided to further define the low-flow channel as a natural watercourse. Although natural revegetation is desirable the channel bottom must be cleaned and maintained to assure that the channel will function as intended (see pl. 5).

2.10 The hike-bike trail crosses the low-flow channel at two points. At these points, low-flow crossings must be provided (see pls. 4 & 5) to eliminate a great deal of maintenance caused by small flows undermining the pavement or depositing mud and other debris. The low-flow crossings will be constructed with corrugated metal pipe (see pl. 5) and are designed to accommodate these small flows.

#### **SIGNAGE**

2.11 Signage is designed to be legible, simple to construct, vandal resistant and easily replaced or repaired. A consistent style of graphics will be used throughout the park.

2.12 There will be two signs at the entrance to the park on Country Club Road (see pls. 3 & 14). The signs will be constructed of reinforced concrete with 16-inch and 12-inch recessed letters. Two 16-inch square brass plaques with the U.S. Army Corps of Engineers Los Angeles District and Pima County Parks and Recreation Department designations will be imbedded into each sign (see pl. 22). These signs will be placed outside the project fence line but within the project limit line (right-of-way of Country Club Road) at an angle to the street to facilitate visibility.

2.13 The remaining seven park signs will be directional or informative and designed for the park user. The signs are designed to employ removable wooden signs which are bolted to a standard reinforced concrete base (see pl. 23). This will facilitate the replacement of damaged or weathered signs.

2.14 The wooden portions of the signs will be constructed of 2-inch thick wood with raised painted letters (recessed background). The letters will be 3 to 4 inches in height, painted light blue to contrast with the dark wood stained background. The materials and construction techniques are similar to those already employed by the Pima County Parks and Recreation Department.

#### **PLANTING**

The planting of the park can be divided into three distinct categories (see pl. 13).

1. Existing vegetation
2. Native planting (in desert areas)
3. Park planting (green species, turf, shade trees, etc.)

**The existing vegetation consists of:**

Desert Broom	<u>Baccharis sarothroides</u>
Creosote Bush	<u>Larrea divaricata</u>
Mexican Palo Verde	<u>Parkinsonia aculeata</u>
Blue Palo Verde	<u>Cercidium floridum</u>
Cottonwood	<u>Populus fremontii</u>
Annual/Perennial Grass	

2.15 This vegetation will provide buffers to disturbed areas (borrow areas) and provide the basic context of the park as a desert park. Removal of existing vegetation will occur only when necessary for the construction of park elements.

2.16 The impact of the low-flow channel will be minimal for most existing species, and will promote natural revegetation of Baccharis sarothroides in borrow area 2. The existing cottonwoods near the basin inlet will no longer receive adequate water due to construction of the low-flow channel. Additional irrigation to these trees will be provided to replace water that will be diverted by the channel.

2.17 Additional native planting will be provided to augment existing vegetation and to provide shade and variety along the hike and bike trail. The low-flow channel will be planted with trees typical of desert watercourses. This planting along with natural revegetation will contribute to the intent of simulating a natural drainage course.

2.18 Native tree plantings must be irrigated during an establishment period of three years. An inexpensive drip irrigation system will be provided for this period and can be abandoned when the trees have established themselves. This three-year period is also coincident with the effective life span of drip irrigation without major renovation.

Native planting will consist of:

Mexican Palo Verde  
Blue Palo Verde  
Mesquite

Parkinsonia aculeata  
Cercidium floridum  
Prosopis juliflora

2.19 The park planting in high use areas (sport fields, picnic area, etc.) will be of a traditional park nature. The Bermuda turf area will be limited to approximately 21.8 acres and will be located in the sport fields and picnic areas. By utilizing the hike and bike trail and fitness course as a mowing edge for turf, maintenance will be greatly facilitated. This technique will also eliminate the ragged edge typical of many parks in desert areas by providing a definite edge or limit of the man-made park.

Park planting will consist of:

Arizona Ash  
Aleppo Pine  
Eucalyptus  
Mesquite  
Cottonwood

Fraxinus velutina  
Pinus halepensis  
Eucalyptus camaldulensis  
Prosopis juliflora  
Populus fremontii

2.20 Most of the park trees will be located in the picnic area, parking lots and the fitness course. The sport fields will remain virtually treeless to maximize field use for organized sports.

#### IRRIGATION

2.21 Water for the park will be taken from an existing 8-inch City of Tucson waterline located in Country Club Road along the east boundary of the project, approximately 40 feet from the point of connection shown on plate 17. The existing 8-inch waterline has been tested by the City of Tucson Water Department at 1827 GPM capacity at 70 psi. To maximize park use and minimize water loss through evaporation, the park should be irrigated at night.

Park irrigation will be of two types:

1. Drip irrigation (native trees and non-turf areas)
2. Spray irrigation (turf areas)

2.22 Drip irrigation will be provided to all trees which are not located in the turf. This technique will minimize water consumption and provide adequate irrigation over long distances (hike and bike trail) at a minimum cost. Additional maintenance will be required to assure emitters are not clogged. Pima County presently employs both drip and spray irrigation on existing parks.

2.23 Water requirements for drip irrigation are minimal. A 10-GPM demand is anticipated for the drip system for a period of 4 hours twice a week during the establishment period of 3 years.

The drip irrigation system will consist of:

Controller	0-4 hour
Valve	Electric solenoid
Pressure regulator	15-30 psi @ 4-GPM
Filter	30 mesh screen
Emitter	Pressure compensating self flushing
Polyethylene tubing	6" depth
PVC main line	18" depth

2.24 Spray irrigation will be provided for all turf areas. Additional irrigation for trees in turf is not anticipated. Low precipitation rate spray heads will be used to maximize soil percolation and reduce water loss due to runoff and evaporation. Water requirements for 21.8 acres of turf will be approximately 301 GPM in times of peak consumption.

The spray irrigation system will consist of:

Controller	0-30 minutes
Valve	Electric solenoid
Pop-up spray head	Low precipitation rate, large radius
PVC pipe	Lateral - 12" depth Main - 18" depth

2.25 The total water requirement for park use has been estimated at approximately 47 million gallons per year. This estimate is based on peak use during the high use months of April through October. Water use for the remaining cool season months is based on a once weekly watering and supplemental tree irrigation. A 250,000 gallon reduction in annual water use is anticipated after the first 3 years of park operation, due to the phase-out of its drip irrigation system.

#### **ELECTRICAL**

2.26 Primary service is available on-site at a point 900 feet south of the maintenance building (not in contract, NIC) on the most southerly boundary line of the project (pl. 19). Power will be taken from this point and installed underground to a central location near the maintenance building (NIC); it will be secondary metered at 277/480 volts.

2.27 Primary duct and a transformer pad will be installed for the local power company's primary wires and transformer. A 480 volt to 120/240 volt transformer will be used to furnish the correct voltage for receptacles, irrigation controls, etc.

Power will be distributed underground in PVC conduit at 277/480 volts to the following:

1. Ramadas
2. Parking lot (dusk to dawn at parking areas)
3. Security lights (dusk to dawn through the sport field and picnic area)
4. Softball fields (for night use by organized sport leagues only)
5. Restrooms
6. Maintenance Building (NIC)

2.28 Power will be on at all times to the parking lot, security and ramada lighting. These items will be controlled through photocells on or in the fixtures. This will allow continuous power for receptacles and irrigation controls. An outdoor-type service entrance panel will be installed adjacent to Restroom No. 2 (pl. 19). The sport field lights will be controlled from this point.

2.29 Parking lot lighting will be installed on round tapered galvanized steel poles 20 feet in height. Each pole will have a type III polycarbonate refractor, tamper-proof hardware and heavy duty aluminum housing. Poles will be spaced approximately 100 feet apart. Security lighting will be similar to parking lot lighting with the exception of spacing, which will approximate that shown on plan, and the use of type V refractors.

2.30 The sport fields will be lighted in accordance with Pima County Parks and Recreation Department standards. The fields will be lighted with (6) 39-foot and (4) 50-foot steel poles. The 39-foot poles will have three fixtures each except for the common poles which will have six (three per field). The 50-foot poles will have four fixtures each. These fixtures will be 1500 watt multi-vapor metal halide lamps. Each field will be lighted with 20 fixtures, drawing approximately 36KW per field. The lighting will yield approximately 30 foot-candles (FC) on the infield and 20 FC on the outfield.

# **PARK ELEMENTS**

### 3. PARK ELEMENTS

#### PARKING LOTS AND PARK ACCESS

3.01 Access to the Tucson Detention Basin recreation area (pl. 3) will be from Country Club Road, both north and south of the detention basin inlet. The southern and primary entry road accesses two parking areas which are located along the east and south boundaries of the picnic area. The east parking area has 66 parking spaces, the south parking area 55 spaces. Another point of access will be provided north of the inlet in order to serve the bicycle motocross course and the archery range. A 27 space parking area will serve these facilities. All three lots will be paved with asphaltic concrete. Typical parking spaces will be 90 degrees to the drive and measure 10 feet in width and 20 feet in depth. The entry drives and aisles will be 24 feet wide. All pavement will be edged with a 6-inch high extruded concrete curb. Five percent (5%) of the spaces will be designed for handicapped users. Security lighting will be provided in all parking areas for night use. All entries and exits will be controlled with locking gates which are standard in all parks in Pima County.

#### PICNIC AREA

3.02 This facility (pl. 3) will be the most visible area from outside of the park. In contrast to most of the park, which is well below street level, the picnic area will be at approximately the same grade as the surrounding neighborhood. The parking lots are adjacent to the picnic area, thus making it readily accessible to all users, including the handicapped.

3.03 It is intended that picnicking families will use one or several ramadas depending on their needs. Grouping the family ramadas offers this type of flexibility. All ramadas will be connected by paths of decomposed granite, an attractive, dustless, comfortable surface. The paths will range from 15 feet to 40 feet in width for ease of maintenance, and to reduce the area of irrigated turf. A tot lot (pl. 24) is located near the center of the picnic area; this will contain various manufactured play structures surrounded by a sand surface. The play structures which will be included are as follows:

- a. One platform structure: This apparatus is constructed of galvanized, painted and stainless steel. Two sets of steps lead to a covered platform 4 feet off the ground. Two slides, each 8 feet in length, provide an alternative exit from the platform. This structure will be secured with a concrete footing.
- b. One climbing apparatus: Constructed of 1-5/8 inch steel pipe with enamel finish, this structure will be secured with a concrete footing. The center pole will extend to a height of 9 feet 6 inches above the ground.

- c. One heavy-duty slide: The slide will be 10 feet in height, 20 feet in length and will be constructed of galvanized and stainless steel. It will be anchored to a concrete footing in order to ensure stability.
- d. Two climber/rider play structures: Resembling large animals or insects, these structures are constructed of painted and galvanized steel. The overall diameter is 6 feet, the height is 2 feet. These items will be anchored to a concrete footing.
- e. One set of extra heavy duty swings: This apparatus will include nine individual swings and will occupy a space 11 feet wide by 54 feet long. The structure will extend 12 feet above the ground. The legs of the swing will be secured in concrete.

A public telephone will be included in the picnic area, next to the restrooms. It will be installed by the telephone company at no charge.

#### **Ramadas**

3.04 The ramadas (pl. 21) are designed to provide shade and allow air to flow freely through the sheltered space. The design is intended to be in harmony with the environment of the desert and the neighborhood, and to be as free as possible from maintenance and vandalism. Columns supporting the roof are to be earth colored split-face concrete block, a durable material not unlike adobe in appearance. Roofs are to be corrugated heavy gauge weathering steel with plywood underlayment. The steel will weather to an attractive bronze color and requires no painting or other treatment. The corrugated weathered steel roof is not only traditional in Tucson, but is also in keeping with the light industrial character of the neighborhood.

3.05 Ramada floors will be concrete, and will extend beyond the roof eave an additional 7 feet to the east to make it possible to follow the shade in the late afternoon. Family ramadas will measure 21 feet long by 18 feet wide. Each family ramada will be furnished with a wood and galvanized steel picnic table with benches attached (8 feet by 3 feet) which is designed to accommodate the handicapped. Also provided at the family ramadas are a steel trash receptacle and a steel barbecue grill (20 inches by 18 inches, pl. 23). The base of the grill will be set in concrete approximately 10 feet from the ramada slab. The group ramadas are designed using the family ramada as a module. Four family ramadas are combined to create a cruciform plan. Each group ramada will be furnished with eight wood and galvanized steel picnic tables (8 feet in length), two steel trash receptacles and a steel and concrete barbecue grill (7 feet by 2 feet). All ramadas will be provided with security lighting.



### **Restrooms**

3.06 Two restroom structures (pl. 20) will be located in the picnic area and will serve users of the sport fields, courts and trails as well as the picnickers. The restrooms are sited at high elevations relative to a major portion of the park in order that they can be served by an existing sewer in Ajo Way and so that they are above the limits of the standard project flood. Each structure (32' by 30'8") will include a men's and women's restroom and will be similar to the ramadas in architectural treatment. The restrooms will depend on natural air circulation for ventilation. Openings (12" high by 11'0" in length) will be provided at one end of each restroom for this purpose. The entry will be left open for air circulation but is designed with a visual lock for privacy. The men's restroom will include two urinals, two water closets and two lavatories. The women's restroom will include four water closets and two lavatories. One water closet and one lavatory in each restroom and at least one urinal in the men's restroom will be for the handicapped. All fixtures will be vandal resistant, cast aluminum. Fixtures such as mirrors and hand driers, which are easily vandalized, will not be provided, at the request of Pima County Parks and Recreation Department. The fixtures will be serviced from a locked storage space between the two plumbing walls of the restroom structure. Lighting will be provided for night use.

### **Maintenance Building**

3.07 A 50-foot by 100-foot maintenance building and yard (pl. 3) is shown in the picnic area. The facility will be used for equipment storage and will serve maintenance personnel. Design and construction of this facility will be funded solely by Pima County and therefore is not detailed in this report.

### **Picnic Area Furniture**

3.08 Picnic area furniture (pl. 23) will consist of 54 wood and galvanized steel picnic tables with attached benches, five group barbecue grills, nine family barbecue grills, 24 steel trash receptacles, ten drinking fountains and 15 park benches. Each family ramada will include one picnic table (8 feet in length), one trash receptacle and one barbecue grill. The grill pedestal will be set in a concrete footing. The unit will be located approximately 10 feet from the ramada. Each group ramada will include eight tables (8 feet in length) and one group barbecue grill (78 inches by 18 inches). This grill will be located approximately 15 feet from the group ramada. Two trash receptacles will serve each structure. An additional five picnic tables, each with a trash receptacle, will be scattered through the picnic area. The drinking fountains will have a concrete body with exposed aggregate finish. The design is one which is accessible to the handicapped and also vandal resistant.

## **SPORT FIELDS AND COURTS**

3.09 These facilities will be multipurpose. The fields include two lighted softball fields with backstops, players' benches, and homerun fences and three soccer/football fields (players' benches and homerun fences will be funded 100 percent by the local sponsor). The soccer/football fields will require portable goals. The fields are located within the limits of the detention basin (see pl. 3) and are raised above the 7-10 year frequency flood level (elevation 2507.5; refer to Grading, page 5 of this report). Access to the field area from the picnic area and parking lot will be from the fitness trail.

3.10 The softball fields will be multipurpose, allowing youth soccer fields (120' x 240') in the outfield of each. This allows youth soccer to be played at night. The soccer/football fields will not be limited to these activities but will provide ample space for activities of a more passive nature requiring large open areas (frisbee, hand launched gliders, etc.); however, the primary purpose of the field area will be to accommodate organized sports.

3.11 The field area will be seeded with Bermuda turf and irrigated with heavy pop-up spray irrigation heads. The entire field area is encircled by the fitness trail which will act as a mowing strip to facilitate maintenance.

3.12 One paved multiuse area, 80 feet by 120 feet, will accommodate two basketball courts, a volleyball court, and two shuffleboard courts. It will have an acrylic colored topping, with sleeves to accept removable volleyball net posts. The heavy duty basketball goals will be permanent. The court is conveniently located adjacent to the fitness trail (pl. 3) which serves as access from the picnic area and parking. (see pls. 3, 11 and 15.)

## **NATURE AREA AND HIKE AND BIKE TRAIL**

3.13 As part of the Tucson Detention Basin recreation area plan, a large amount of the total project land will be left undeveloped. This is due in part to the necessary function of the detention basin and in part to the economic constraints of the project. It is fortunate that a large portion of this area is rich in plant and animal life. The dominant shrub within the basin is Baccharis. It is hoped that the site can continue as a habitat for birds and small animals. The jogging and bicycle path will be constructed with minimum site disruption. The appearance of the area along the path will be enhanced by adding groves of desert trees, thus giving spatial variety to the jogger's experience. The path will be approximately 6000 feet in length. It will be constructed of asphaltic concrete, 8 feet in width. Vehicular access to the path for maintenance purposes will be provided from both the north and south parking lots. This feature will allow maintenance vehicles sufficient access when the basin is partially filled. The hike and bike trail will also serve as a paved edge between the grassed portions c

the park and the natural area. This feature will contribute to ease of maintenance and will create a sharp visual edge between the man-made park and the desert.

#### **FITNESS COURSE**

3.14 An 18-station fitness course, combined with elements for the handicapped, will encircle the sport fields, and offer convenient access to parking and the picnic area. The 8-foot wide path is paved with asphaltic concrete, and is 4200 feet in length. Its west end is shared with the hike and bike trail, at which point the path becomes 12 feet wide. Each station of the course will be a combination standard and handicapped exercise station.

3.15 The fitness course has 14 individual pullout areas, which will be paved with asphaltic concrete (see pl. 22). Each pullout will contain one or two exercise stations, depending on location and distance to the next or previous station. This arrangement offers variety to the course. By staggering stations and lengths of time needed to complete exercises, user conflicts on days of heavy use will be minimized.

#### **ARCHERY RANGE**

3.16 A two-station archery range will be constructed in a somewhat remote location in the northeast corner of the detention basin. This facility has been placed to avoid conflict with other park activities. The size of the range is approximately 175 feet by 75 feet. Archers will shoot from south to north, with the north bank of the detention basin forming a backstop for the range. A service road-pedestrian way will provide access from the parking lot. The archery range will be lightly screened from nearby sport fields using groupings of desert trees. The range will be cleaned and graded as necessary, and left in a natural state to the greatest extent possible. Targets and other equipment will be provided by Pima County Parks and Recreation Department, as these are not cost shareable items.

#### **BICYCLE MOTOCROSS**

3.17 A bicycle motocross course will be constructed for the area north of the low-flow channel and adjacent to Country Club Road. Here the change in elevation at the northerly bank of the basin will add excitement to the riding experience. Unsightliness, noise and dust created by this activity dictate that this facility be isolated from other park elements. The bicycle motocross course will be partially screened from the picnic area and will be accessible by an entry and small parking lot (27 spaces) separate from the rest of the park's facilities (pls. 3, 12, & 16). The course will be 1100 feet in length. The width of the course will be 12 feet and the surface will be native soil. Baccharis sarothroides (desert broom), planted strategically (pl. 13), may help to cushion the impact of riders leaving the course involuntarily. A public telephone will be included as part of this facility and will be installed in the parking area by the telephone company at no charge.

**PHASE 1**

**DEVELOPMENT SCHEDULE  
AND COSTS**

#### **4. PHASE I DEVELOPMENT SCHEDULE AND COSTS**

##### **SCHEDULE OF DEVELOPMENT**

4.01 All further work on the Tucson Detention Basin recreational development will stop pending receipt of funds. Once project funding has been secured, plans and specifications for construction can begin immediately. Preparation of the construction documents will require approximately six months. Advertisement, award, and completion of the construction contract will require an additional twelve months (Fig. 3).

##### **COST ESTIMATES**

4.02 This Feature Design Memorandum is taken to the detail necessary to proceed to final construction documents. The estimates presented in this report include the costs for construction of the Phase I recreation facilities, for engineering and design (E&D), supervision and administration (S&A), and for contingencies. In general, recreation development costs will be shared equally by the Federal Government and the local sponsor; those facilities which are ineligible for cost sharing will be constructed entirely at Pima County's expense. The non-cost shared facilities are referenced, both in the body of the report and in the cost tables.

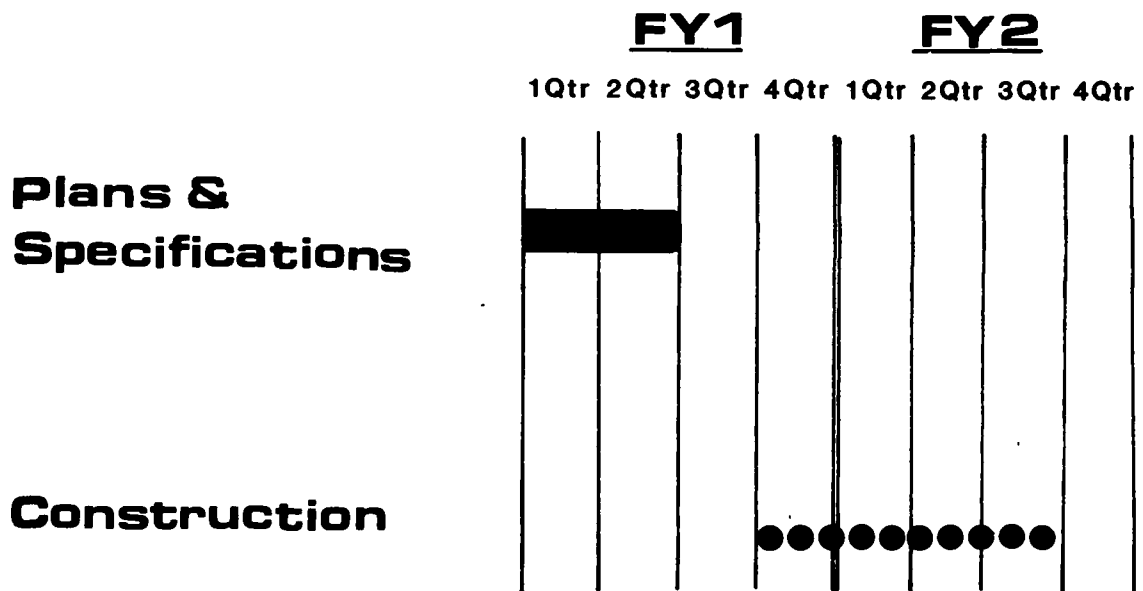
4.03 A summarization of the Federal and non-Federal project costs is provided in table 1 below. These costs are derived from the following sources:

- a. Corps of Engineers Study  
Preliminary Flood Detention Dams Design and Cost Report,  
Tucson Urban Study. December 1978.
- b. Current Construction Costs 1980  
Lee Saylor, Inc.
- c. Means Cost Data 1980  
Robert Snow Means Company, Inc.
- d. Known costs in the Tucson area, based on 1980 bid prices  
for projects of similar size and nature.

Source d. was used where possible. When no consistent trend in local unit prices could be determined, the other sources were used. All estimates are based on October 1980 prices.

# **Tucson Diversion Channel\***

## **Phase I Sport Fields & Picnic Area**



**\*Construction of Tucson Diversion Channel  
was completed in 1966**

**Figure 3 Development Schedule**

Table 1 - Cost Summary

<u>ACTIVITY AREAS</u>	<u>COSTS<sup>1</sup></u>		<u>TOTAL</u>
	<u>NON-FEDERAL</u>	<u>FEDERAL</u>	
Sport Fields	\$281,000 <sup>2</sup>	\$280,000	\$561,000
Picnic Area	358,000	358,000	716,000
Hike/Bike Trail	16,000	16,000	32,000
Archery/Motocross	15,000	15,000	30,000
Fitness Trail	12,000	12,000	24,000
Low Flow Channel	24,000	24,000	48,000
Subtotal	706,000	705,000	1,411,000
Contingency (20%)	141,000	141,000	282,000
E&D (10%)	85,000	85,000	170,000
S&A (6%)	51,000	51,000	102,000
Total	\$983,000	\$982,000	\$1,965,000

<sup>1</sup>All costs shown are rounded to the nearest 1,000.

<sup>2</sup>Includes costs for player's benches, which are not cost shared.

4.04 The itemized cost calculations for Phase I development, from which this summary is derived, are provided in tabular form, by activity area, in Appendix B of this report.

#### DISCUSSION OF COST INCREASES

4.05 There has been a considerable increase in the estimated cost for Phase I of the project, as compared to the estimate presented in the October 1981 Master Plan. This increase is due primarily to modifications to the earlier recreation development plan. The more significant modifications include:

- a. Addition of grouted rip-rap to a portion of the low flow channel.
- b. An expanded and re-designed sport field area, which will make better use of the site. The larger field area in turn has engendered increases in grading, clearing and grubbing, and lighting estimates.
- c. A fitness trail that now provides parallel facilities to accommodate handicapped as well as non-handicapped users.
- d. An asphaltic concrete rather than a graded, natural base hike/bike trail, to improve the facility's safety and durability.
- e. A more intensively developed picnic area, which can accommodate more users than could the original plan.

- f. A drip irrigation system to ensure the establishment of desert plantings outside of the basin's turfed area.
- g. Additional parking to accommodate users of the larger and/or more intensive facilities cited previously.

4.06 Although all costs for spectator seating have been deleted and the acreage of turf requiring irrigation has been reduced, the cumulative effect of all revisions has been to increase the overall project cost. Some of the increase is also attributable to inflation; master plan costs are based on October 1979 price levels, as compared to the FDM's October 1980 figures. Table 2 displays the master plan and FDM cost estimates for Phase I development.

Table 2 - Master Plan and FDM  
Cost Comparison

ITEM	Master Plan (Oct 1981)		FDM (Feb 1983)	
	FEDERAL	NON-FEDERAL	FEDERAL	NON-FEDERAL
Phase 1 Development	538,000	538,000	705,000	706,000
Cont.	108,000	108,000	141,000	141,000
E&D	65,000	65,000	85,000	85,000
S&A	39,000	39,000	51,000	51,000
Total	750,000	750,000	982,000	983,000

#### Project Operation and Maintenance Requirements

4.07 Costs to operate and maintain the Phase I development are estimated at \$132,000 annually (March 1982 price levels). A detailed breakdown of this estimate, which includes costs for water, mowing and trimming, utilities, personnel, and supplies, is provided in Table 3. This estimate is based on Pima County's expenditures for operation and maintenance of existing county parks that are comparable to the Tucson Detention Basin in size and type of development.



Table 3 - Estimated Annual Operation and Maintenance Costs

<u>ITEM</u>	<u>ESTIMATED QUANTITY</u>	<u>UNIT</u>	<u>UNIT COST</u>	<u>TOTAL COST</u>
1. Mowing	690	Hr.	\$8.69	\$6,000
2. Trimming	368	Hr.	8.69	3,200
3. Fertilizer				
Materials			LS	900
Labor	64	Hr.	12.00	800
Equipment	8	Day	55.00	400
4. Turf Aeration	1	Job	LS	600
5. Irrigation Repairs				
incl. Materials and Labor	1	Job	LS	5,900
6. Spraying				
incl. Materials and Labor	1	Job	LS	1,600
7. Utility Cost				
Water			Annual	19,100
Electricity			Annual	10,000
Gas			Annual	3,000
8. Personnel Cost				
Leadworker (1)			Annual	18,000
Park Maintenance Worker (3)			Annual	45,500
9. Supplies and Materials				
Chemicals			LS	3,800
Irrigation Materials			LS	2,900
Maintenance Supplies			LS	3,500
Janitorial Supplies			LS	1,200
Paint Supplies			LS	300
Transportation			LS	5,500
Total Annual Operation and Maintenance				\$132,200

**CONCLUSIONS &  
RECOMMENDATIONS**

## **5. CONCLUSIONS AND RECOMMENDATIONS**

### **CONCLUSIONS**

5.01 This feature design memorandum discusses the comprehensive development recommended for the Tucson Detention Basin. From the information presented herein, it is generally concluded that:

- a. The plan optimizes the use of land for flood control, open space, and recreation development. The primary purpose of flood control will be maintained and the secondary purposes of recreation and open space will be provided.
- b. Construction of the Tucson Detention Basin development plan will enhance recreation opportunities in Pima County.
- c. Development of the plan will help the demands for certain types of day-use activities. It will significantly increase opportunities for picnicking, a variety of field sports and court games, archery, jogging, and bicycling.
- d. Rapid urban growth in the Tucson metropolitan area makes the detention basin valuable for recreation and open space.
- e. Hydrologic and hydraulic considerations have been used in planning activities and their locations in the basin to insure user safety.
- f. The development plan optimizes the use of available project lands with respect to cost and future demands.
- g. The development plan has strong local support from officials, departments, and user groups.
- h. The Pima County Parks and Recreation Department will operate and maintain the facilities and manage the resources in continuity with their management policies for other recreation areas.
- i. The development plan is functional; its maintenance will not overtax environmental or energy resources.

### **RECOMMENDATIONS**

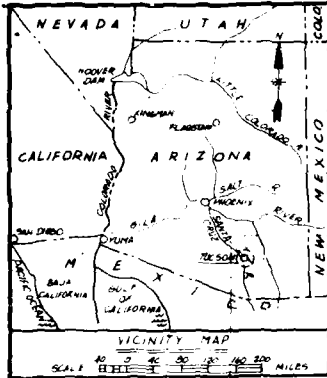
5.02 It is recommended that this feature design memorandum be approved to serve as a general guide for future design, development, and management of the project lands.

**APPENDIX A**

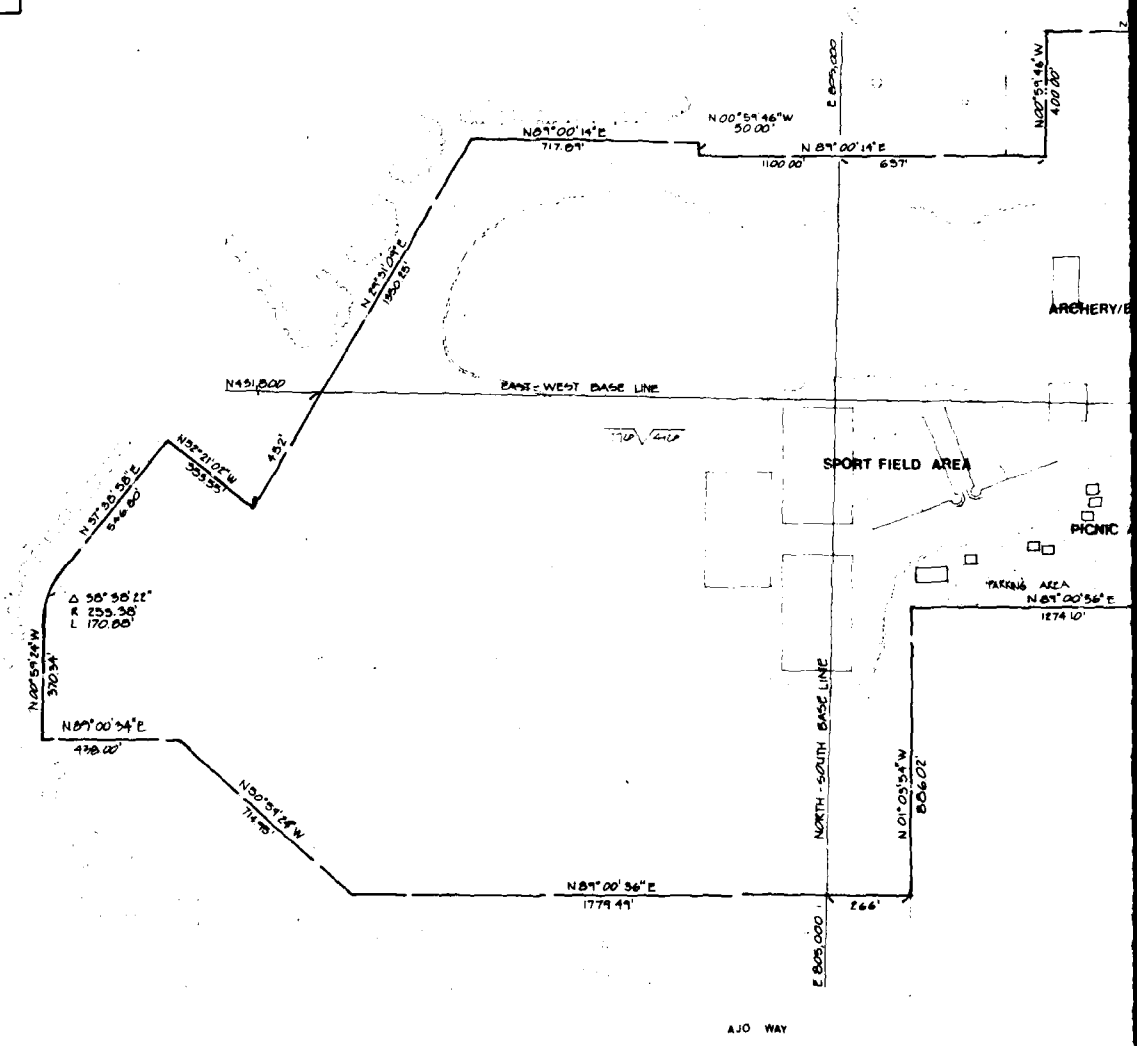
**PLATES**

# LIST OF PLATES

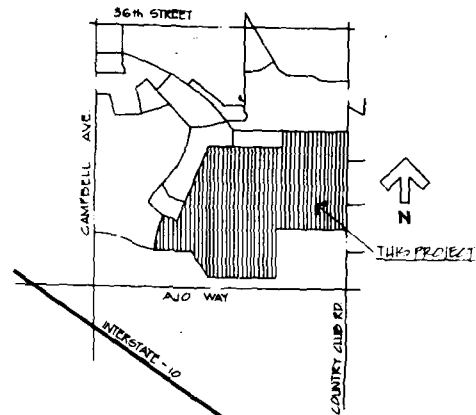
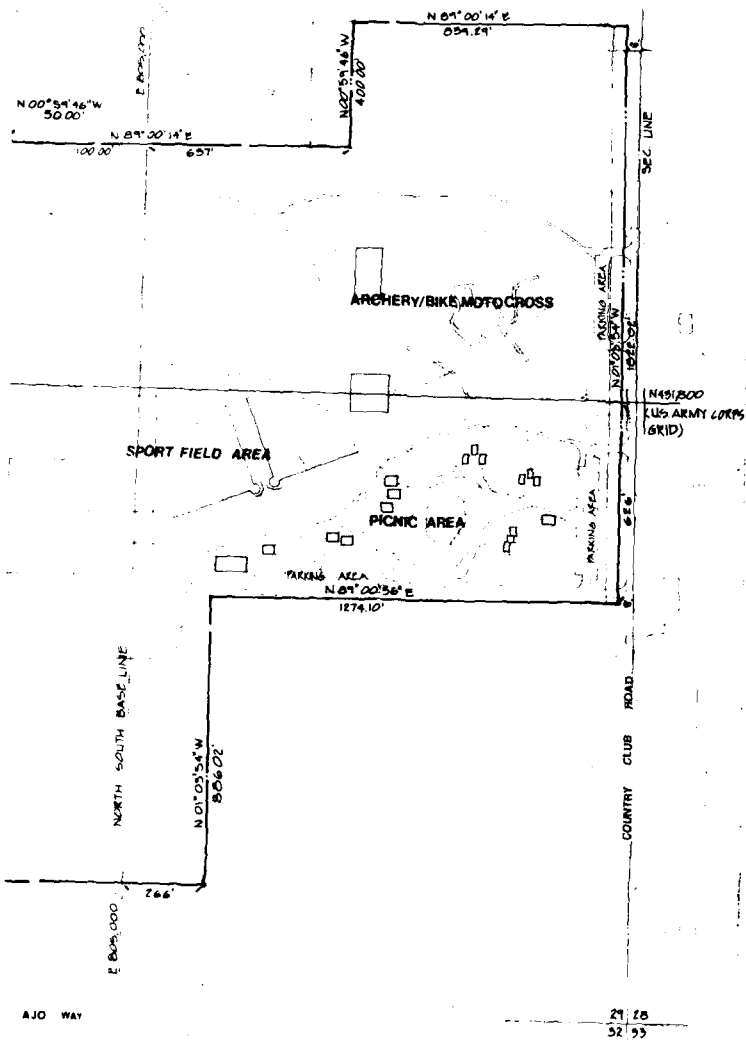
<u>Plate Number</u>	<u>Title</u>
1	Site Horizontal Control
2	Site Sketch
3	Site Plan
4	Site Grading
5	Cross Sections & Site Details
6	Cross Sections & Site Details
7	Cross Sections & Site Details
8	Cross Sections & Site Details (Borrow Area 1)
9	Cross Sections & Site Details (Borrow Area 2)
10	Grading (Picnic Area)
11	Grading (Fields & Picnic Area)
12	Grading (Archery/Motocross)
13	Site Planting
14	Site Plan (Picnic Area)
15	Site Plan (Fields & Picnic Area)
16	Site Plan (Archery/Motocross)
17	Site Irrigation & Domestic Water
18	Sewer
19	Electrical
20	Restrooms
21	Ramadas
22	Fitness Trail Detail & Entry Sign
23	Signage, Park Furniture
24	Tot Lot



ENVIRONMENTAL  
ENHANCEMENT  
THRU ENGINEERING



# VALUE ENGINEERING PAYS

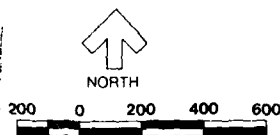
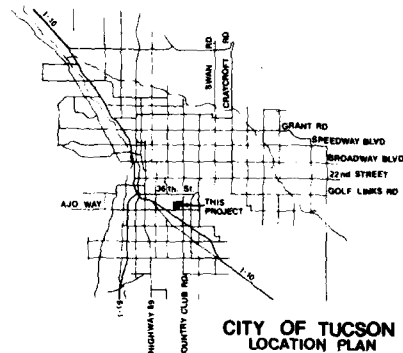


LOCATION PLAN

A PORTION OF SEC. 29, T. 14-S, R. 4-E  
6190E 1/4, PIMA COUNTY, ARIZONA

## NOTES

1. APPROX COORDINATE BASED U.S. ARMY CORPS OF ENGINEER AERIAL SURVEY TITLED TUCSON DIVERSION CHANNEL, DETENTION BASIN PARK, ARIZONA FILE NO. AR-2414
2. BEARINGS ROTATED 90° 51' 02" CLOCKWISE FROM DEED, BOOK 776 AT PAGE 418 IN ORDER TO APPROXIMATE CORPS OF ENGINEERS GRID.
3. DISTANCES ARE DEED DISTANCES
4. REFER TO PLATE 5 FOR SITE PLAN



SYMBOL		DESCRIPTIONS	DATE	APPROVAL
<p>MYRICK - NEWMAN - DAHLBERG, INC. U.S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS</p>				
DESIGNED BY	<p>GILA RIVER BASIN ARIZONA TUCSON DIVERSION CHANNEL USE I SPORT FIELDS &amp; PICNIC AREAS SITE HORIZONTAL CONTROL</p>			
DRAWN BY				
CHECKED BY				
SUBMITTED BY	DATE APPROVED	SPEC NO. DAWOP	SHEET 1 OF 24	
		DISTRICT FILE NO.		

SAFETY PAYS

PLATE 1

VALUE ENGINEERING PA

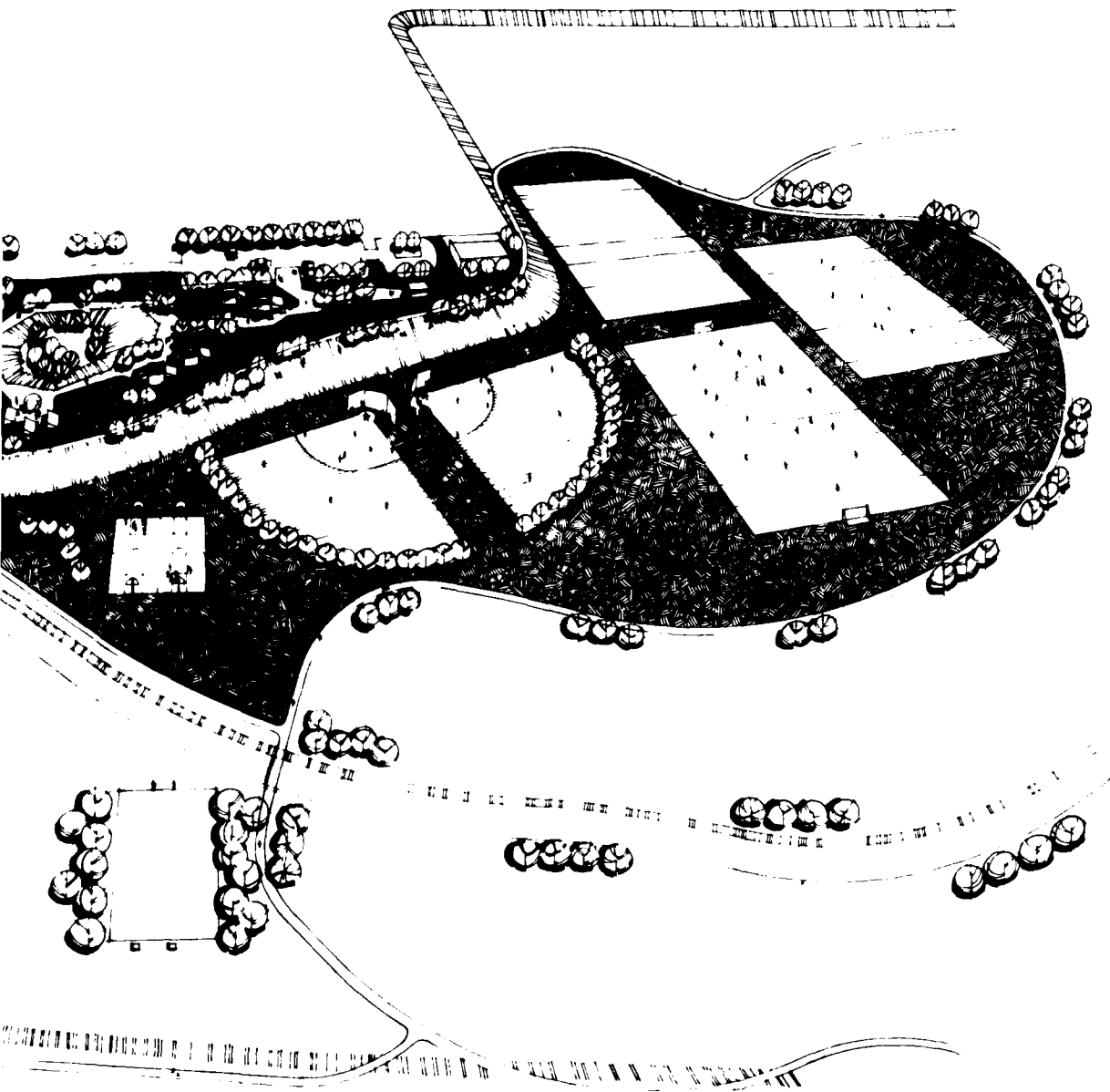
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MANAGEMENT  
THRU ENGINEERING



SAFETY PAYS



# VALUE ENGINEERING PAYS



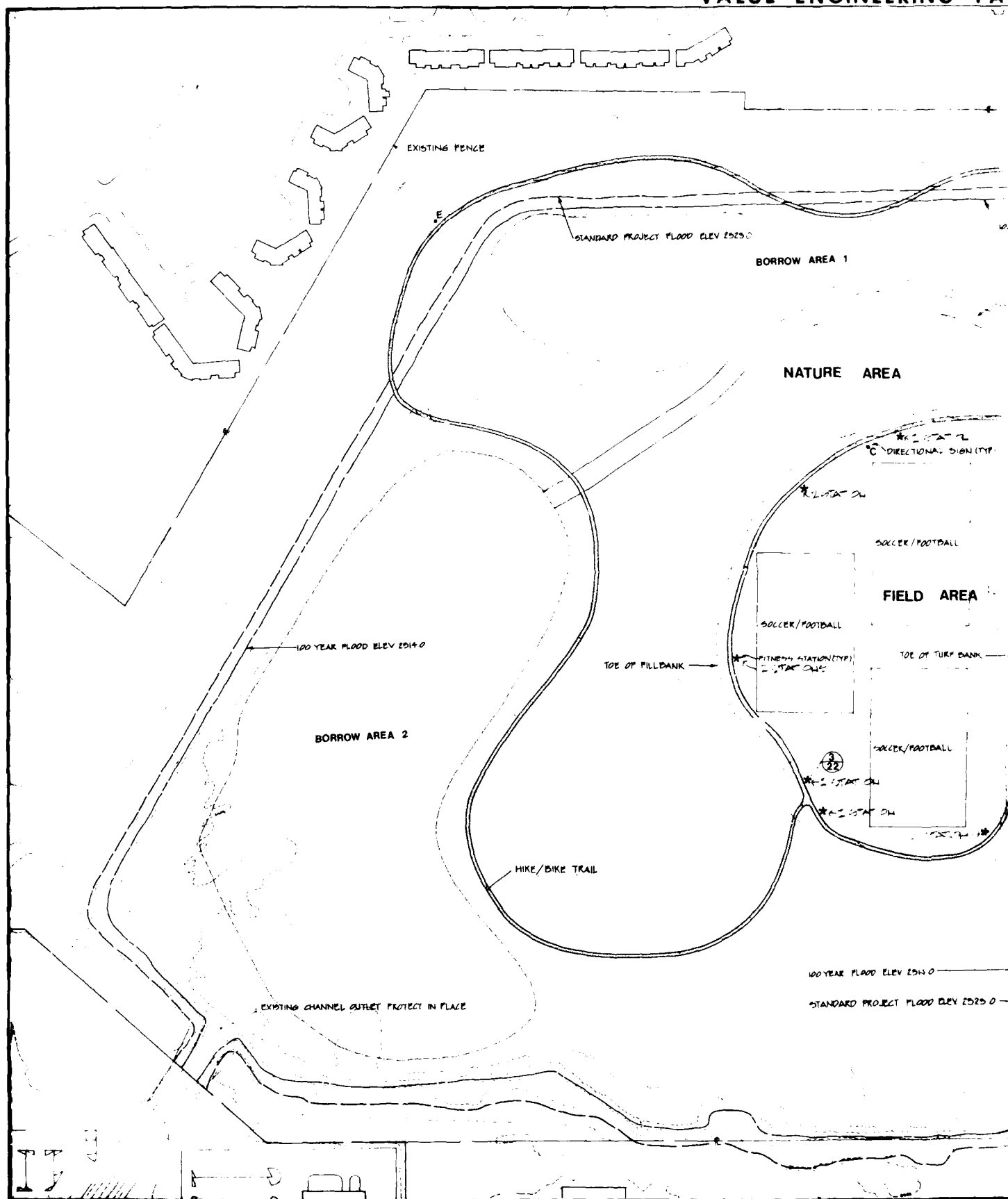
SEP 17 1981

REVISIONS		DATE	APPROVAL
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DESIGNED BY:	<b>GILA RIVER BASIN ARIZONA</b> <b>TUCSON DIVERSION CHANNEL</b> <b>PHASE I SPORT FIELDS &amp; PICNIC AREAS</b> <b>SITE SKETCH</b>		
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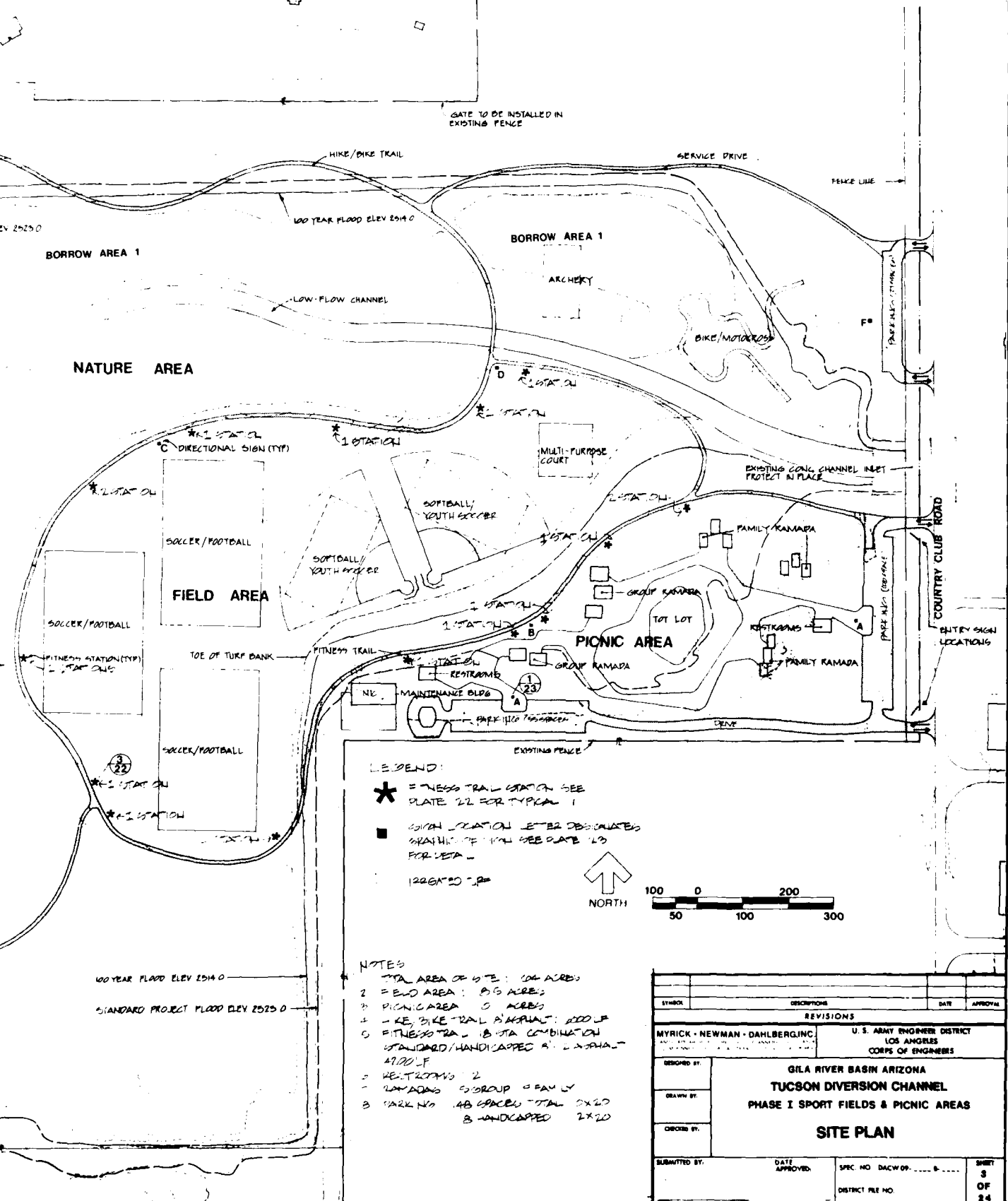
**SAFETY PAYS**

**PLATE 2**

2



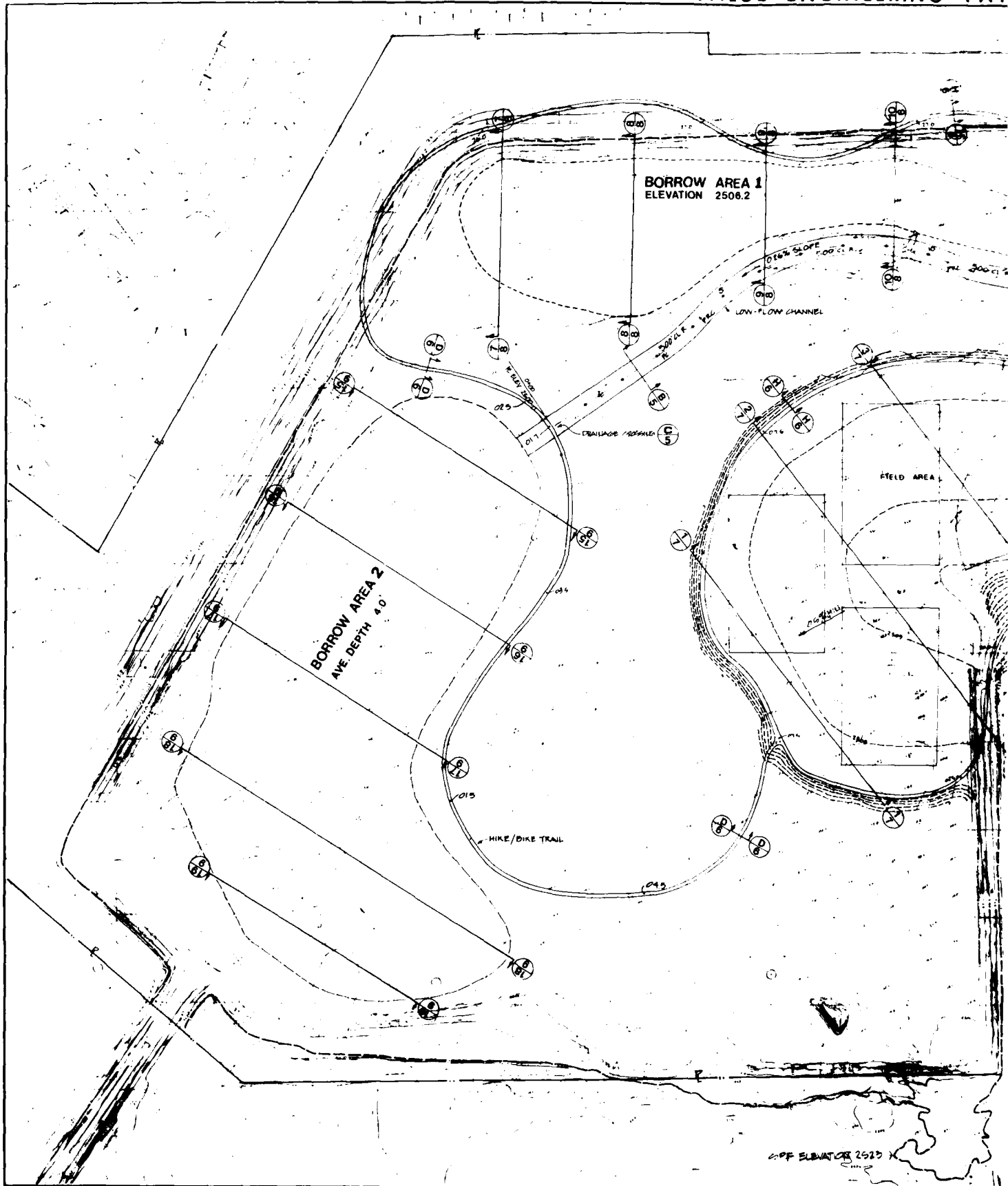
VALUE ENGINEERING PAYS



SAFETY PAYS

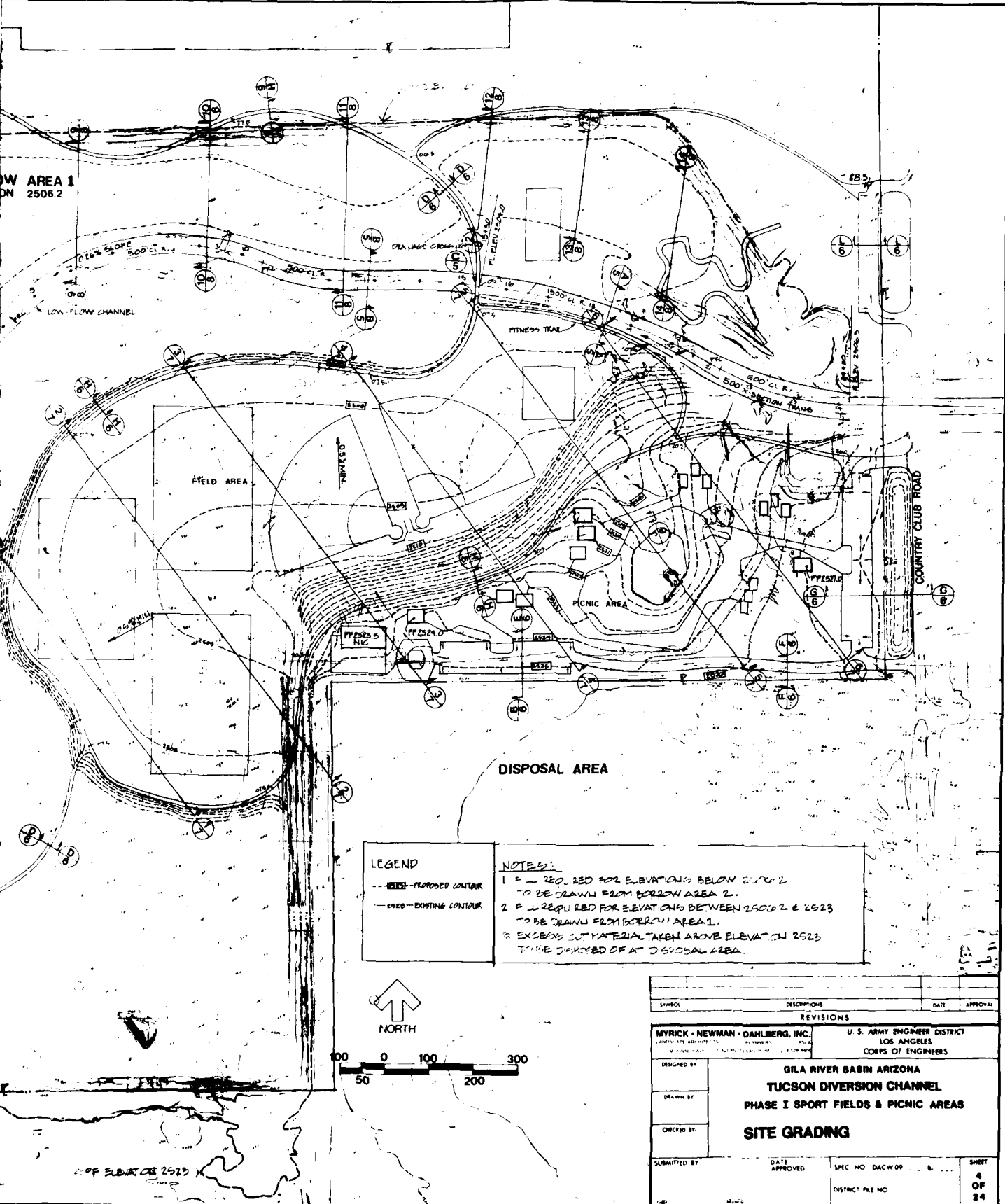
PLATE 3

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DESIGNED BY:	GILA RIVER BASIN ARIZONA TUCSON DIVERSION CHANNEL PHASE I SPORT FIELDS & PICNIC AREAS			
DRAWN BY:	<b>SITE PLAN</b>			
CHECKED BY:				
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## SAFETY PAYS

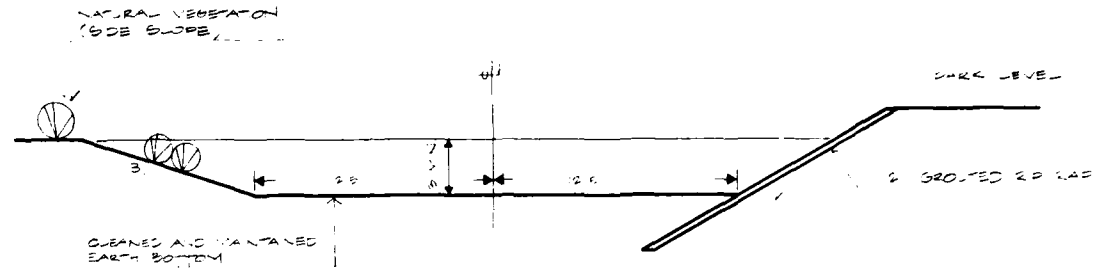
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SAFETY PAYS

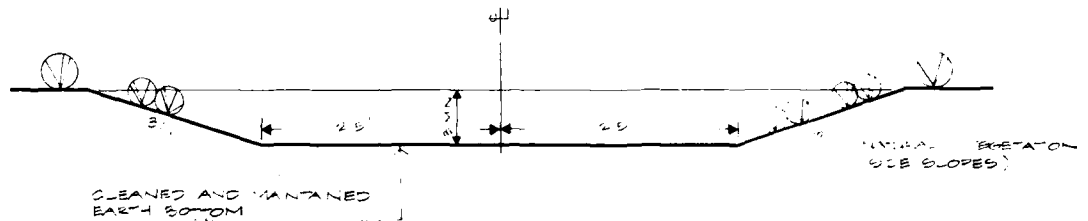
PLATE 4

MYRICK • NEWMAN • DAHLBERG, INC.		U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS	
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		DISTRICT FILE NO.	



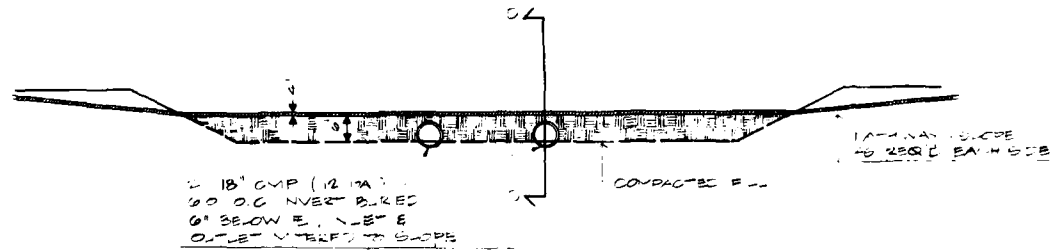
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 $S_1 = 0.24\%$   
 $V_1 = 7.9 \text{ FPS}$   
 $Q_{100} = 384 \text{ CFS}$   
 $Q_{25} = 300 \text{ CFS}$



X - SECTION B-B

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 $S_1 = 0.24\%$   
 $V_1 = 7.9 \text{ FPS}$   
 $Q_{100} = 384 \text{ CFS}$   
 $Q_{25} = 300 \text{ CFS}$



LOW-FLOW CROSSING DETAIL C

ENVIRONMENTAL  
ENGINEERING  
THRU ENGINEERING

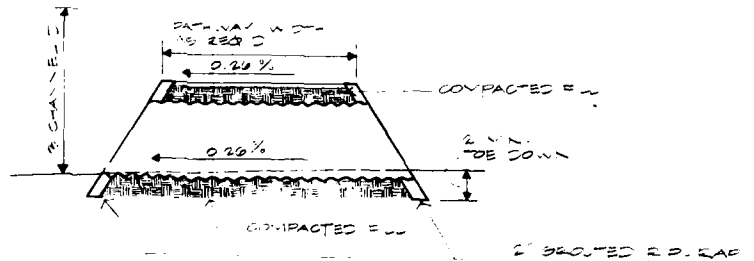
# VALUE ENGINEERING PAYS

DARK LEVEL

2 BROOKED R.D. KAP

NATURAL VEGETATION  
(SEE SLOPES)

1:1 NATURAL SLOPE  
TO ROAD EACH SIDE



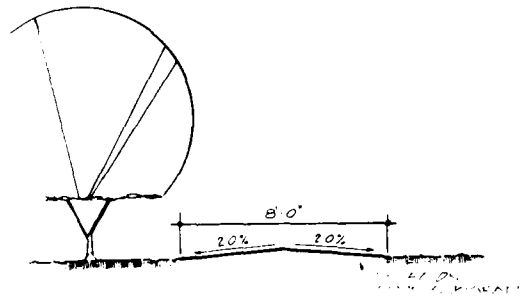
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SYMBOL		DESCRIPTIONS		DATE	APPROVAL
REVISIONS					
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DESIGNED BY:	GILA RIVER BASIN ARIZONA TUCSON DIVERSION CHANNEL PHASE I SPORT FIELDS & PICNIC AREAS				
DRAWN BY:	CROSS SECTIONS & SITE DETAILS				
CHECKED BY:					
SUBMITTED BY:	DATE APPROVED:	SPEC. NO. DACW 09-.....	SHEET 5 OF 24		
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SAFETY PAYS

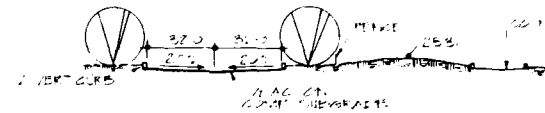
PLATE 5

2



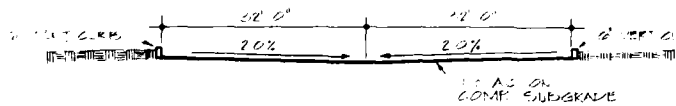
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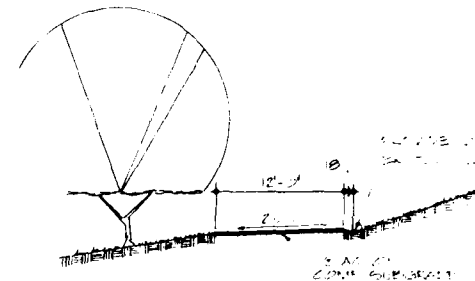
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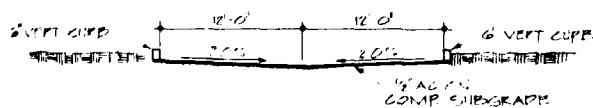
X - SECTION E-E

UTG



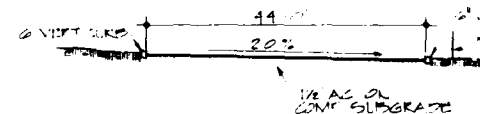
X - SECTION H-H

UTG



X - SECTION F-F

UTG



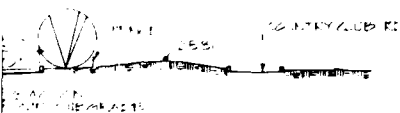
X - SECTION L-L

UTG

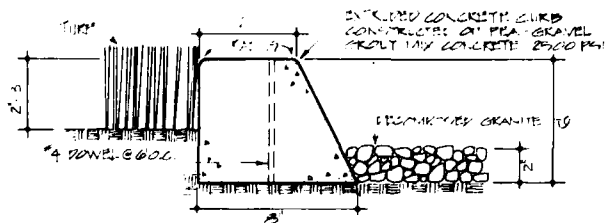
ENVIRONMENTAL  
ENHANCEMENT  
THRU ENGINEERING



# LUE ENGINEERING PAYS



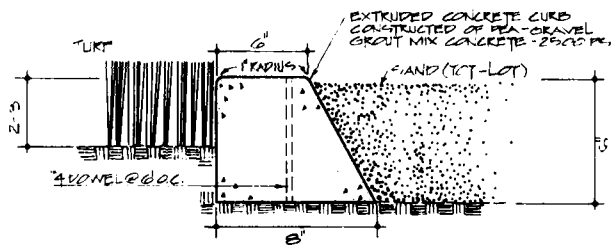
SECTION G-G



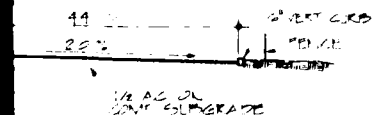
X - SECTION J-J



SECTION H-H

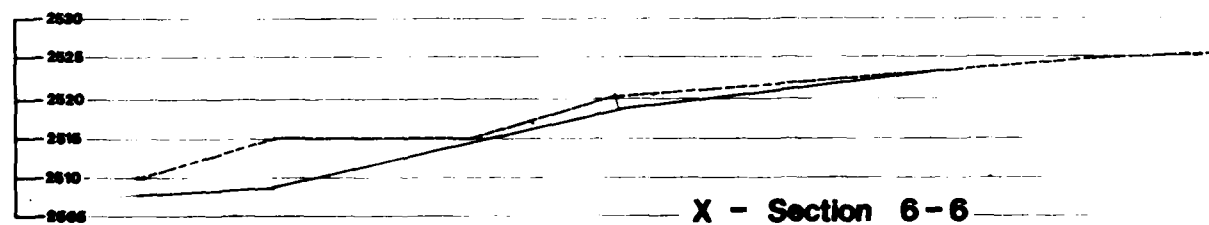
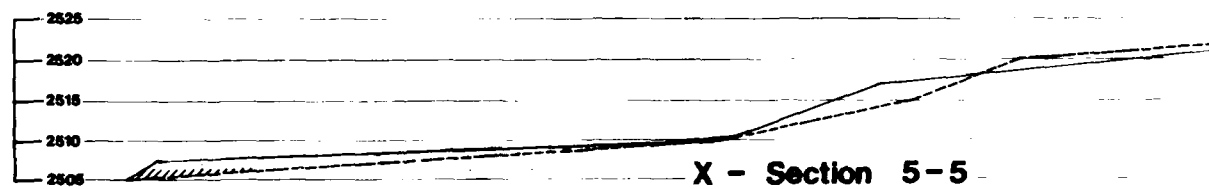
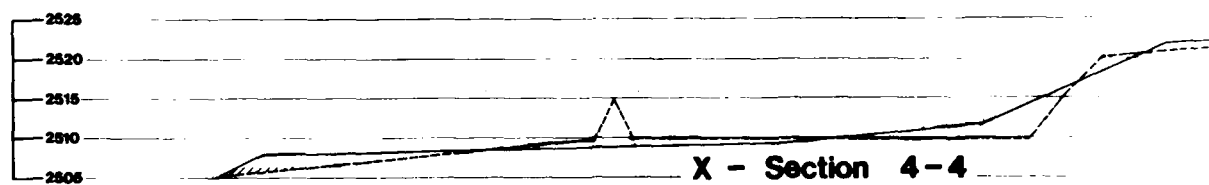
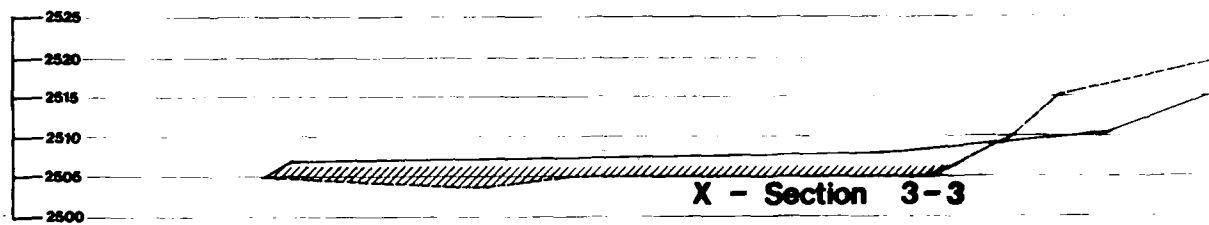
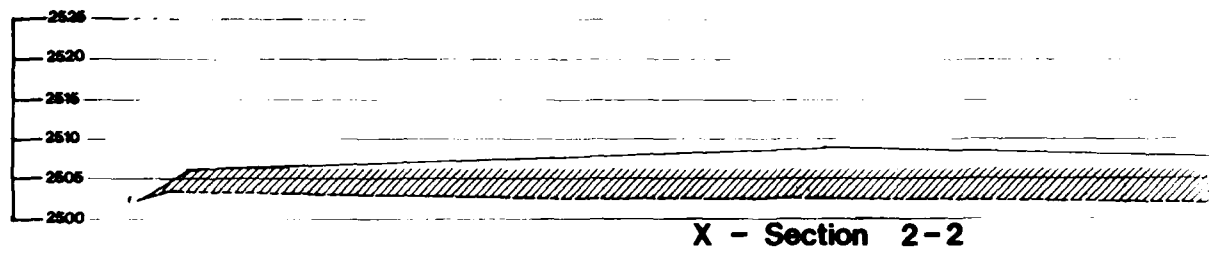
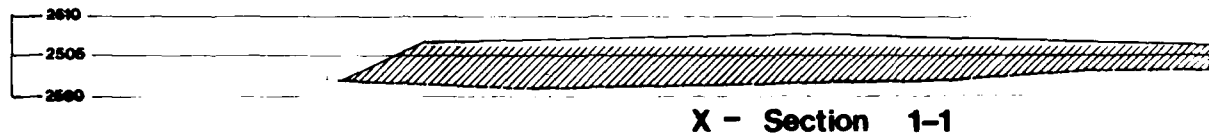


X - SECTION K-K



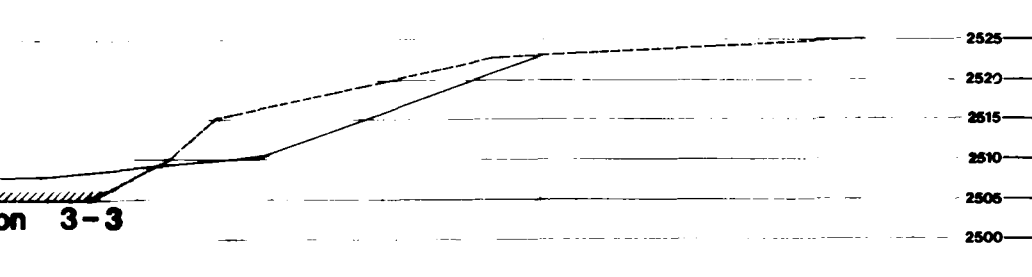
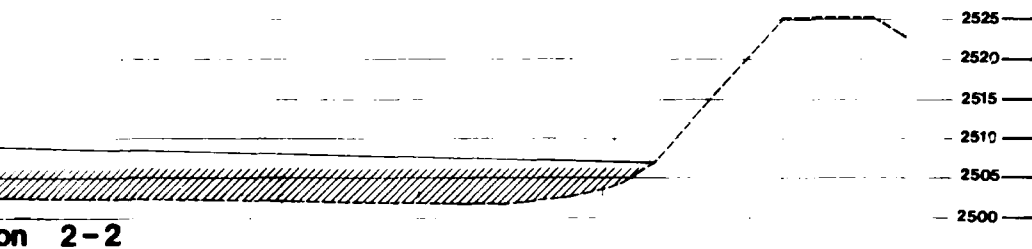
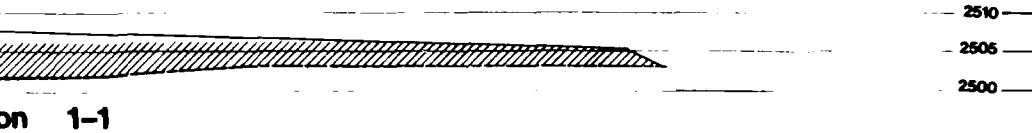
SECTION L-L

SYMBOL		DESCRIPTIONS		DATE	APPROVAL
REVISIONS					
MYRICK - NEWMAN - DAHLBERG INC.			U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS		
DESIGNED BY	GILA RIVER BASIN ARIZONA TUCSON DIVERSION CHANNEL PHASE I SPORT FIELDS & PICNIC AREAS				
DRAWN BY	CROSS SECTION & SITE DETAILS				
CHECKED BY	DATE APPROVED: _____ SPEC. NO. DACW 09- _____ DISTRICT FILE NO. _____				
SUBMITTED BY	SHEET 6 OF 24				



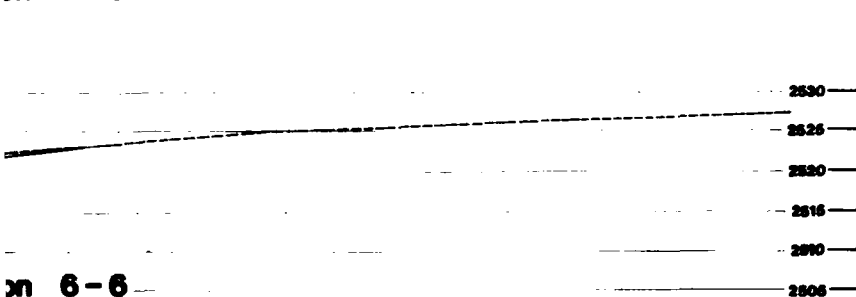
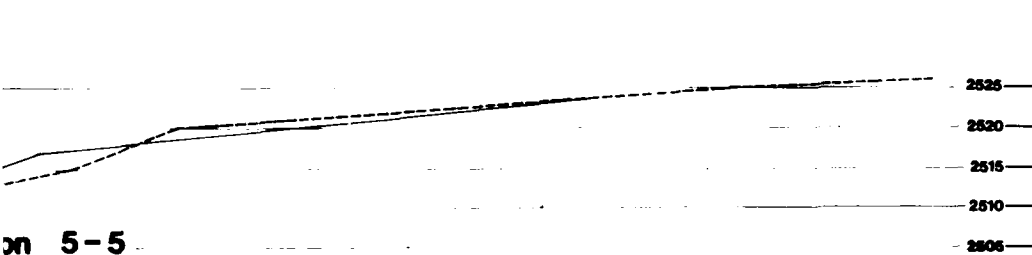
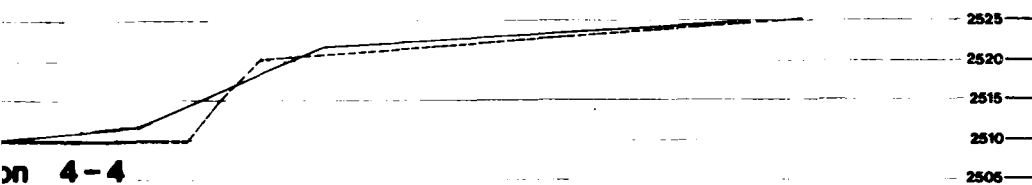
ENVIRONMENTAL  
ENHANCEMENT  
THRU ENGINEERING

# ALUE ENGINEERING PAYS



100420 YDS TOTAL FILL - 0% SLOPE  
 14615 YDS TOTAL FILL BELOW 2500.2  
 3,813 YDS TOTAL FILL ABOVE 2500.2  
 1833 YDS TOTAL CUT SEC. TWO (1)  
 5161 YDS ADJUST. QUA. REQUIRED ABOVE 2500.2

SHADING DELETES ELEVATIONS BELOW 2500.2



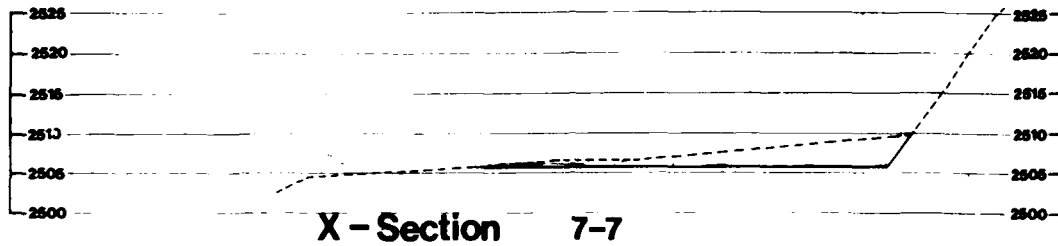
HOR. SCALE 50 0 50 100  
 VERT. SCALE 10 0 10 20

SEP 17 1961

SYMBOL		DESCRIPTION		DATE	APPROVAL
REVISIONS					
MYTRICK - NEWMAN - DAHLBERG, INC. LANDSCAPE ARCHITECTURE - PLANNERS 1501 W. HUNTER - DALLAS, TEXAS 75201 - 214 528 4400			U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS		
DESIGNED BY:	OLA RIVER BASIN ARIZONA TUCSON DIVERSION CHANNEL PHASE I SPORT FIELDS & PICNIC AREAS <b>CROSS SECTION &amp; SITE DETAILS</b>				
DRAWN BY:					
CHECKED BY:					
SUBMITTED BY:	DATE APPROVED:	SPEC. NO. DRAWN BY:	SHEET 7 OF 24		DISTRICT FILE NO.

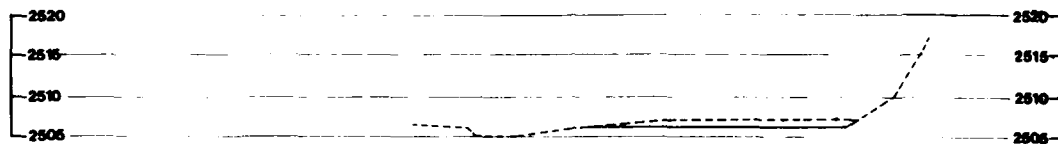
SAFETY PAYS

PLATE 7



X - Section 7-7

X



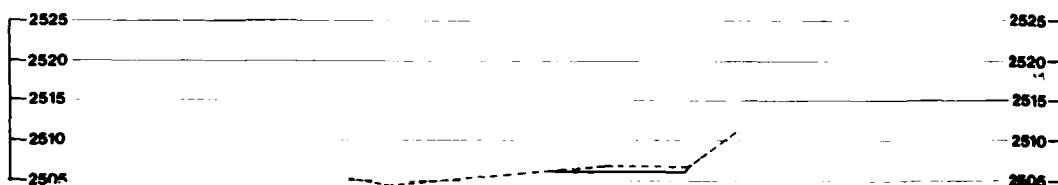
X - Section 9-9

X



X - Section 11-11

X



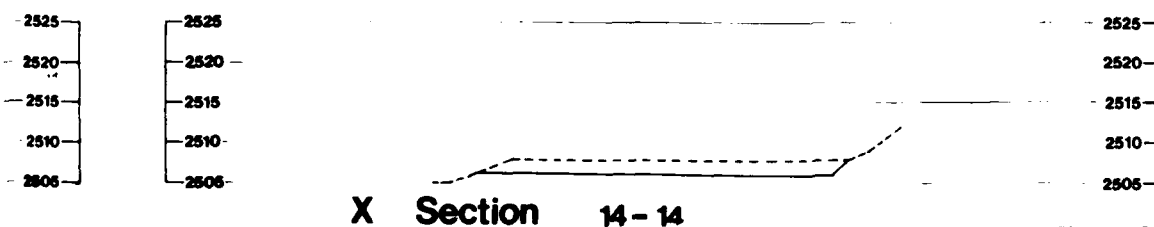
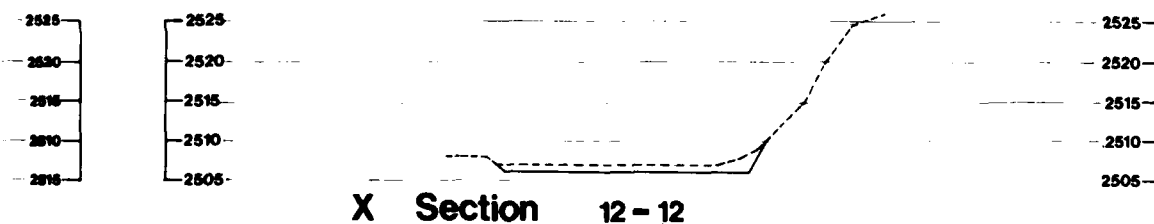
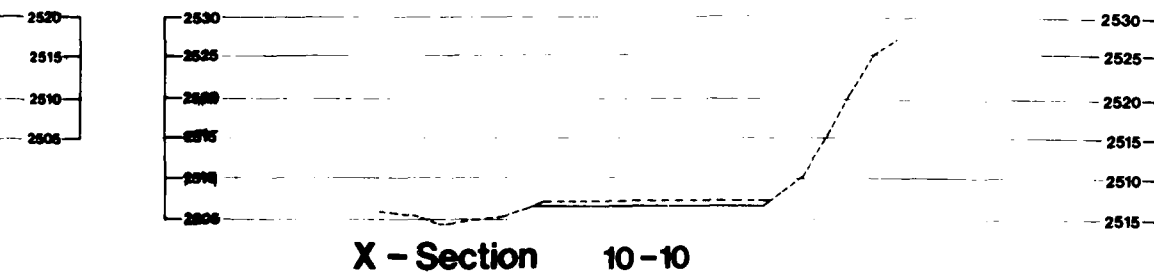
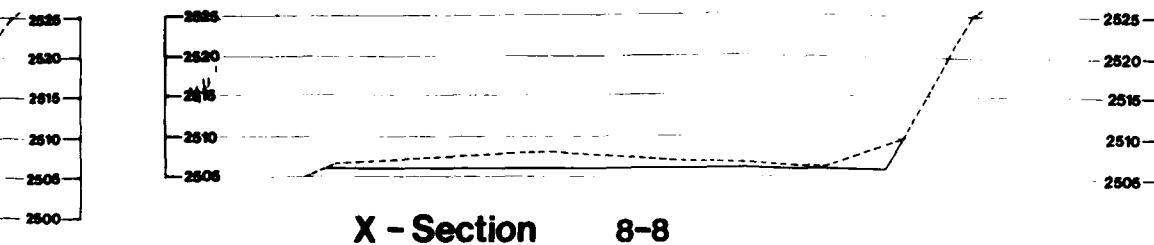
X Section 13-13

X

ENVIRONMENTAL  
ENHANCEMENT  
TRUCK ENGINEERING

14718.70 AVAILABLE

# VALUE ENGINEERING PAYS



HOR. SCALE 0 50 100  
VERT. SCALE 0 10 20

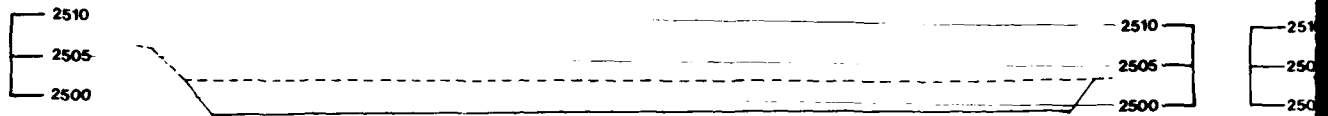
16,118 YD<sup>3</sup> AVAILABLE BORROW AREA 1

BYRICK • NEWMAN • DAHLBERG, INC.		U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS	
DESIGNED BY: <b>GILA RIVER BASIN ARIZONA</b> DRAWN BY: <b>TUCSON DIVERSION CHANNEL</b> CHECKED BY: <b>PHASE I SPORT FIELDS &amp; PICNIC AREAS</b> SUBMITTED BY: <b>CROSS SECTION &amp; SITE DETAILS</b> DATE: <b>BORROW AREA 1</b> APPROVED: _____ SPEC. NO. BACKW. _____ DISTRICT FILE NO. _____			
SHEET 8		OF 24	

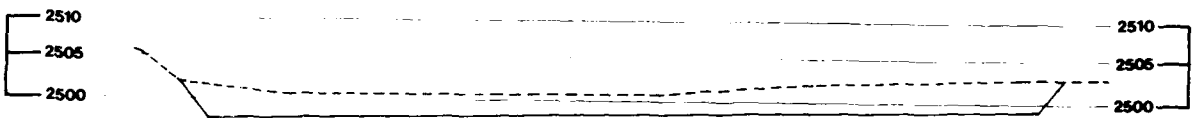
SAFETY PAYS

PLATE 8

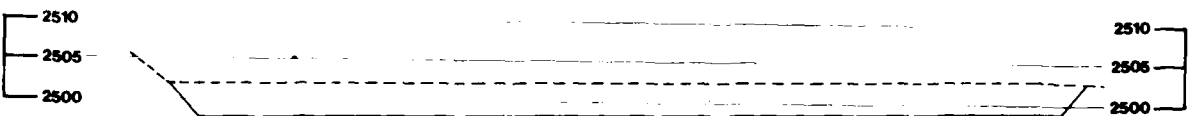
2



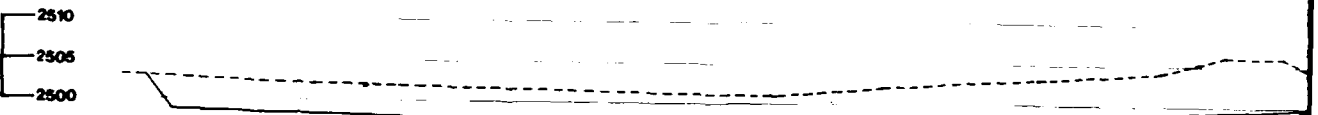
**X - Section 15 - 15**



**X - Section 16 - 16**



**X - Section 17 - 17**



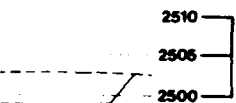
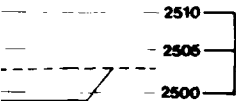
**X - Section 18 - 18**

ENVIRONMENTAL  
ENHANCEMENT  
THRU ENGINEERING

## BLUE ENGINEERING PAYS



**X Section 19-19**



87024 VD<sup>3</sup> AVAILABLE BORROW AREA 2



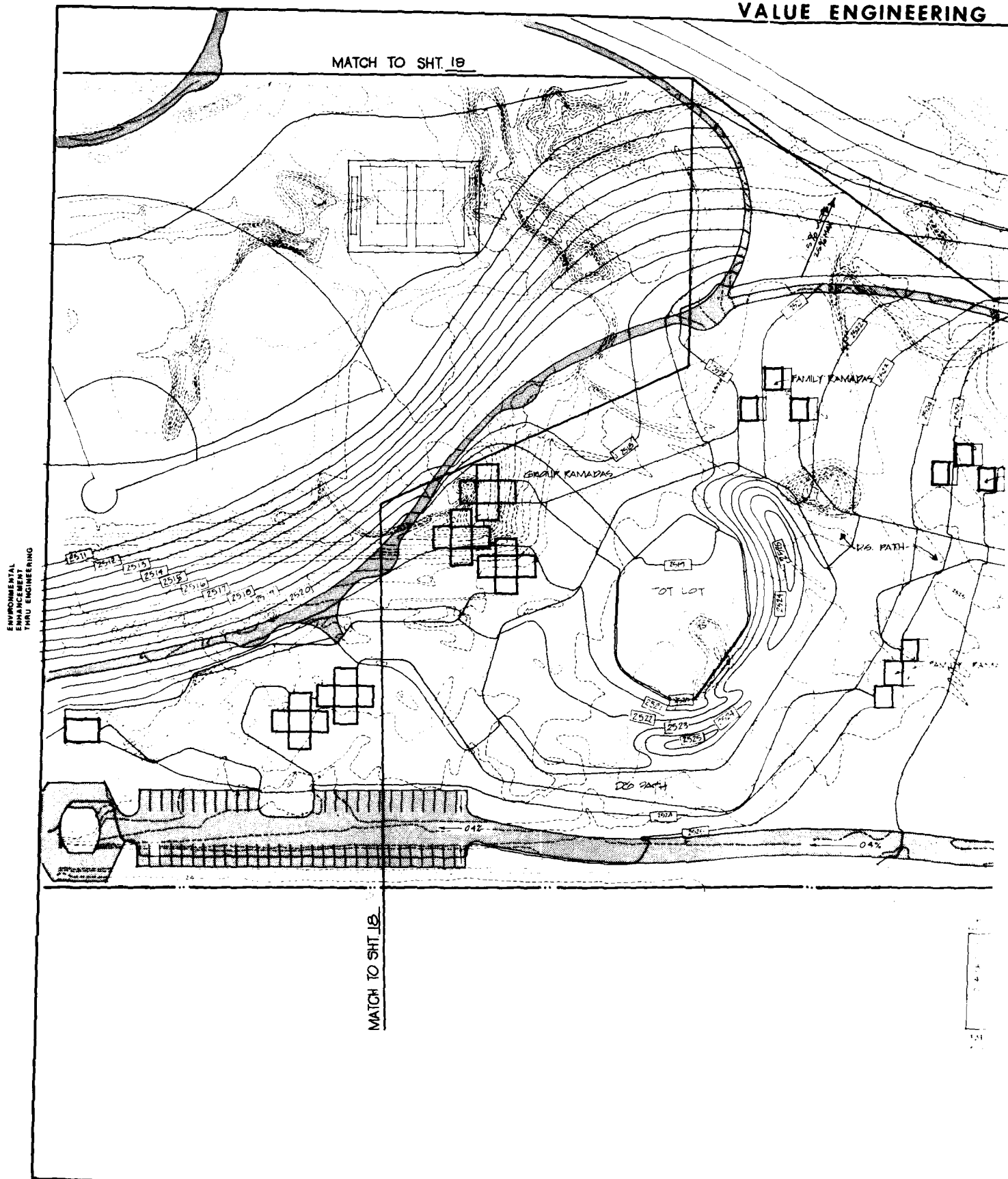
**HOR. SCALE**     50     0     50     100  
**VERT. SCALE**     10     0     10     20

SEP 17 1961

PROJECT		DESCRIPTION		DATE	
REVISIONS					
MYTRICK - NEWBMAN - DANBERG, INC. ENGINEERS AND ARCHITECTS 1001 W. 10TH AVENUE DENVER, COLORADO 80202			U. S. ARMY BISHOP DISTRICT FORT ARNOLD CORPS OF ENGINEERS		
DESIGNED BY: _____ CHECKED BY: _____ DRAWN BY: _____			GILA RIVER BASIN ARIZONA TUCSON DIVERSION CHANNEL PHASE I SPORT FIELDS & PARK AREAS <b>CROSS SECTION &amp; SITE DETAILS</b> <b>BORROW AREA 2</b>		
SUBMITTED BY: _____		DATE APPROVED: _____		SPEC. NO. BACW OF: _____ DISTRICT FILE NO. _____	
SCALE: _____		SHEET: _____		OF 24	

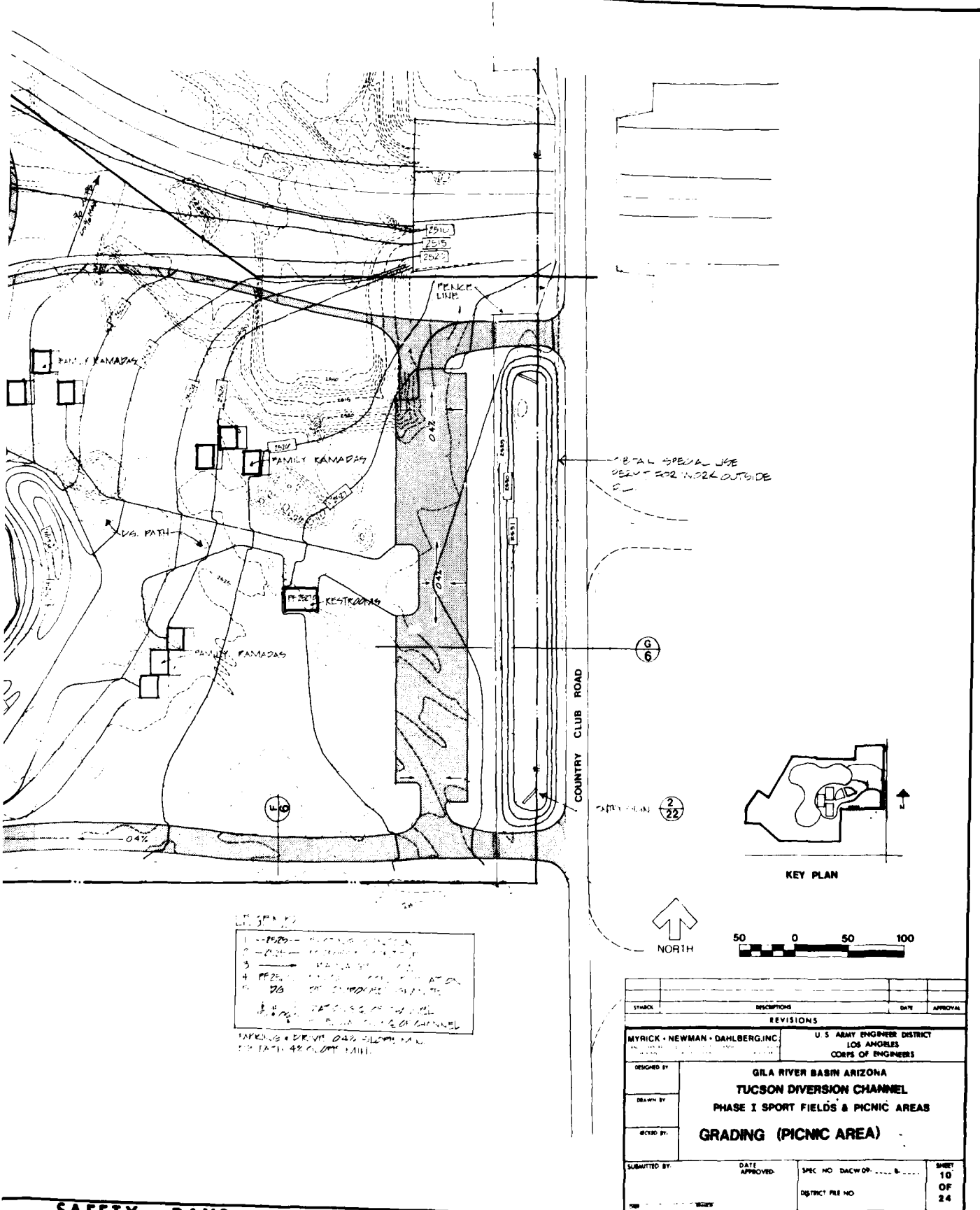
## **SAFETY PAYS**

**PLATE 9**



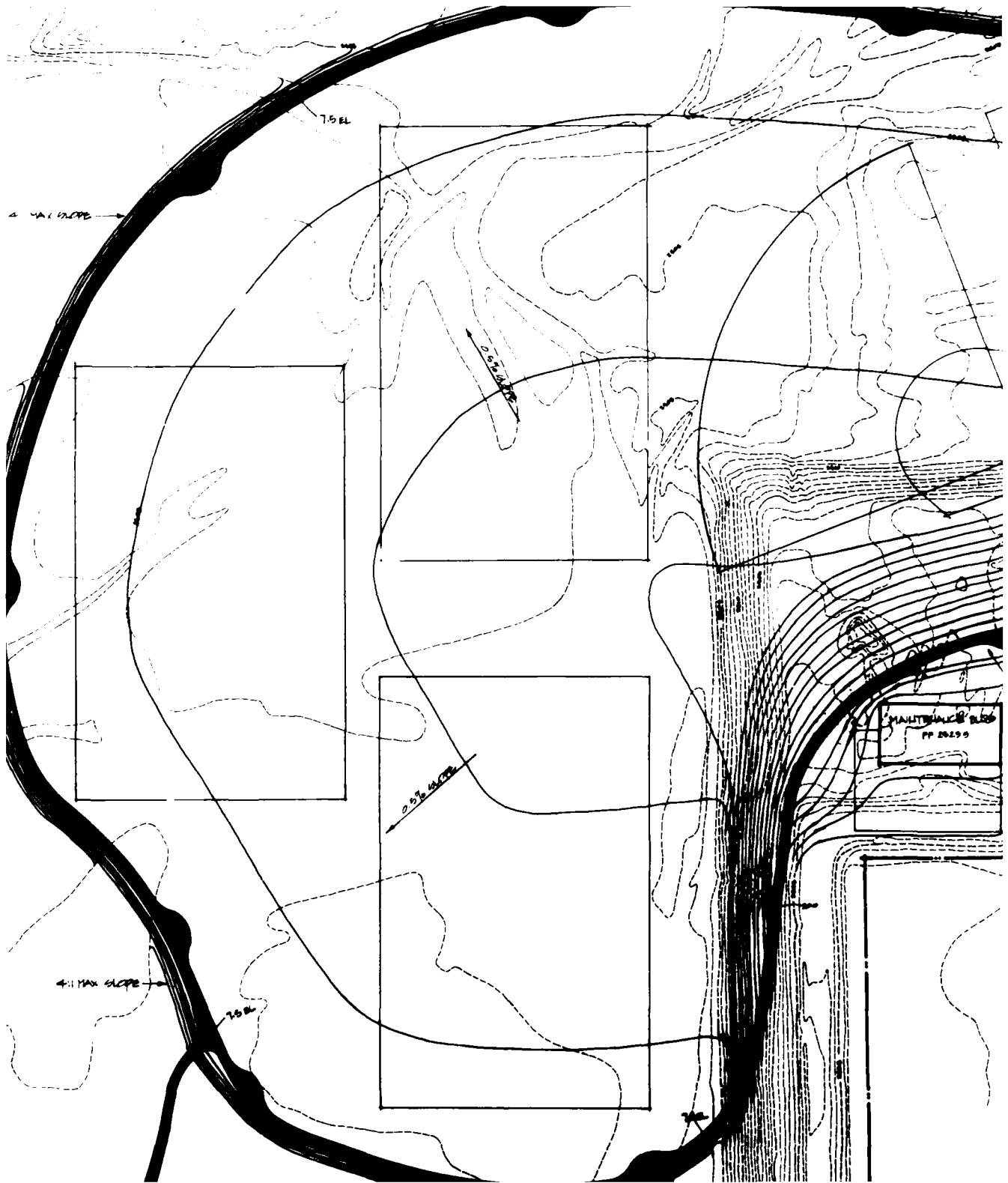


VALUE ENGINEERING PAYS

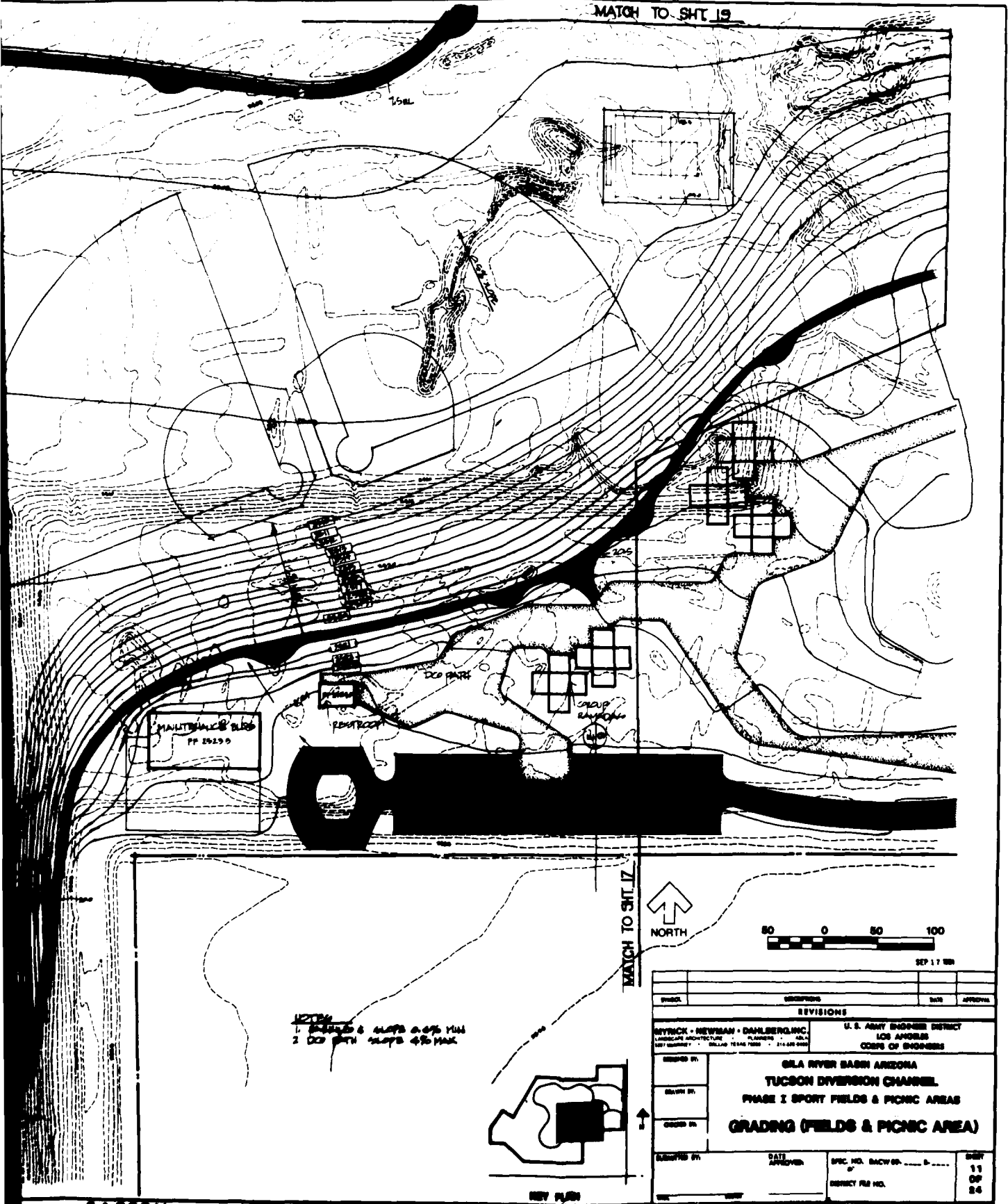


SAFETY PAYS

PLATE 10



VALUE ENGINEERING PAYS



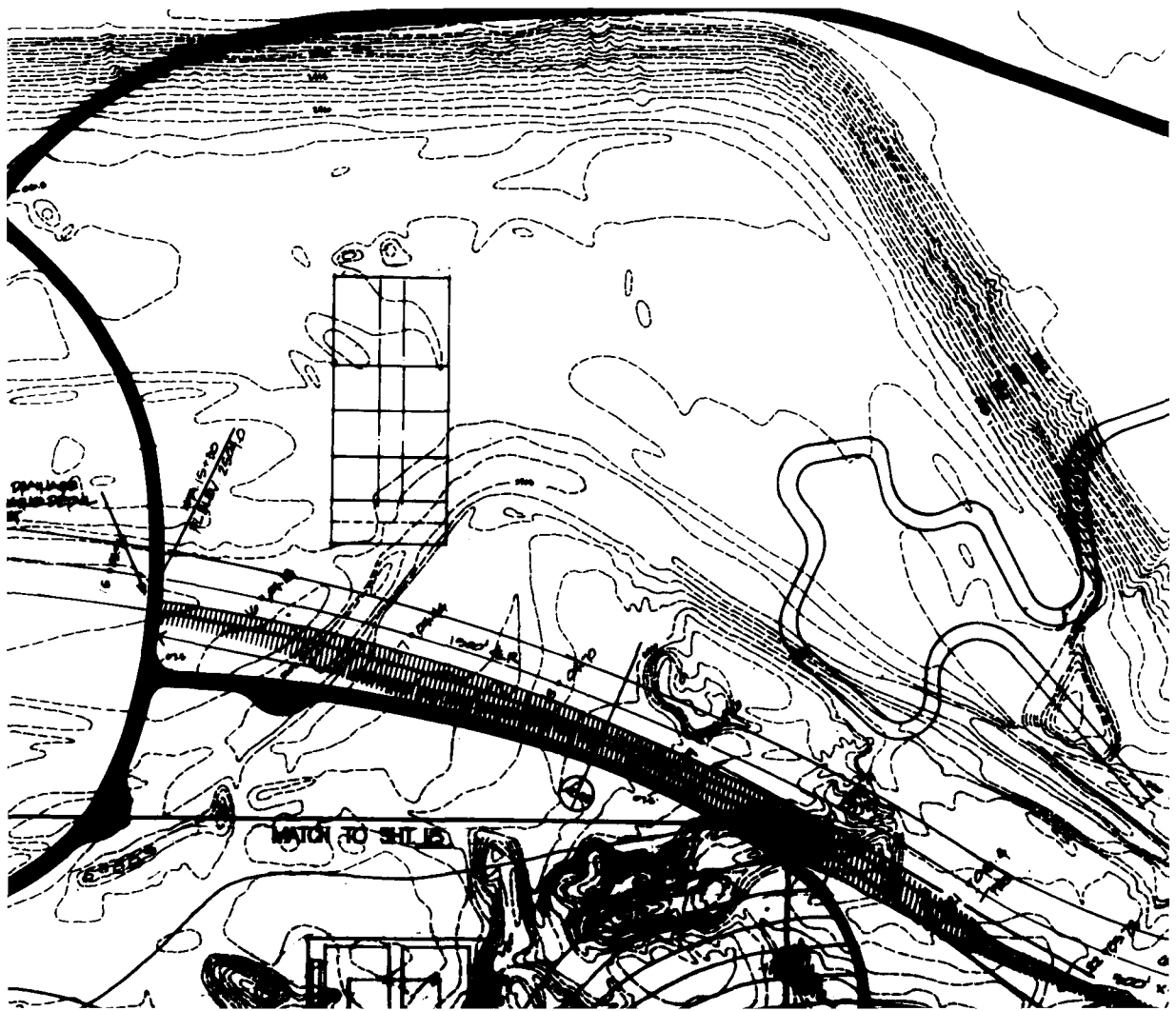
NOTES  
1. GRADE & SLOPE 2:1% MAX  
2. DO PATH SLOPE 4:1% MAX

REVISIONS	
NO.	DESCRIPTION

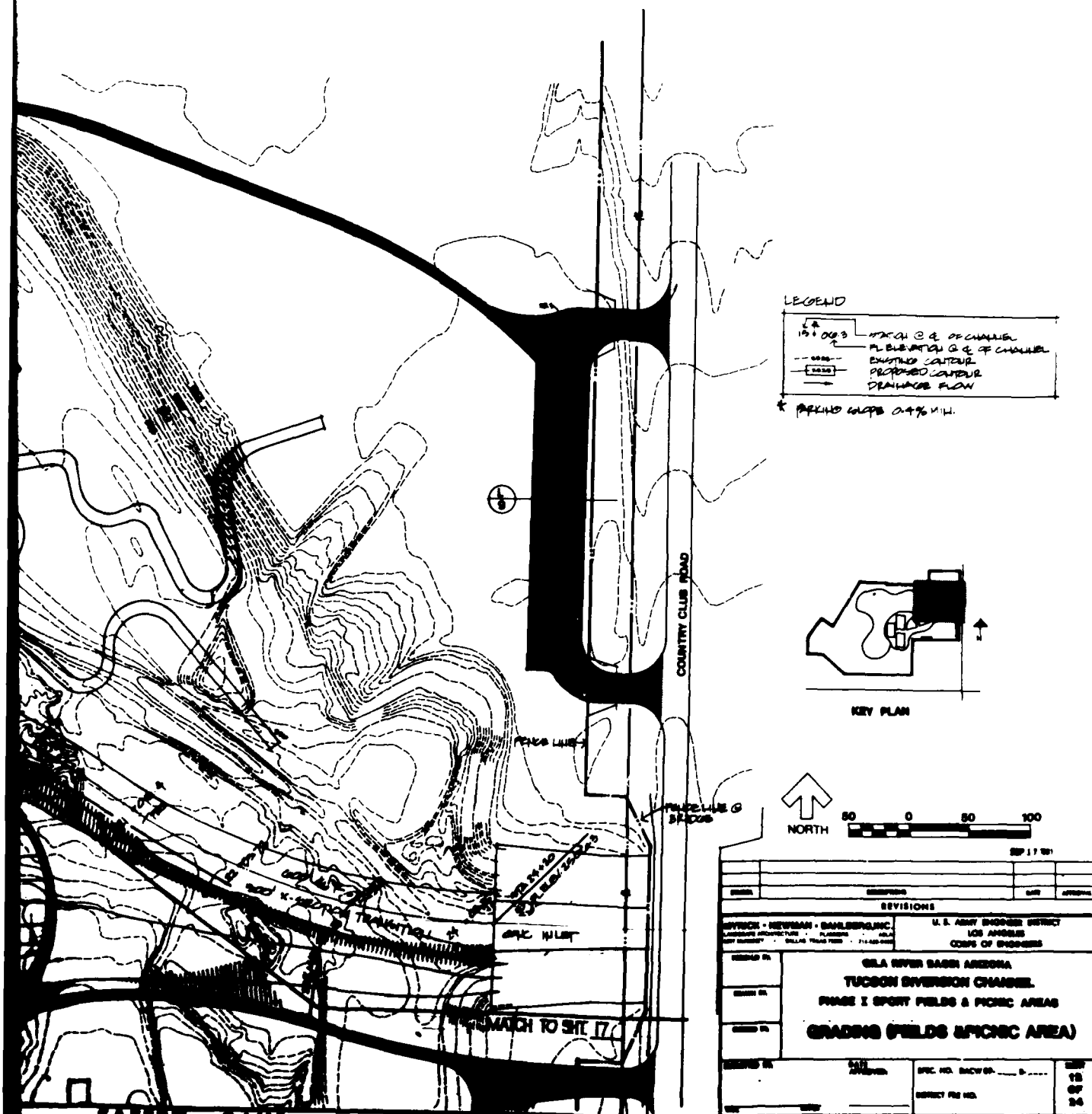
BYRICK - NEWMAN - DANLBERG, INC. LANDSCAPE ARCHITECTURE - PLANNERS 10101 DALLAS TEXAS 75243		U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS	
GILA RIVER BASIN, ARIZONA TUCSON DIVERSION CHANNEL PHASE I SPORT FIELDS & PICNIC AREAS GRADING (FIELDS & PICNIC AREA)			
DESIGNED BY	DATE	SPEC. NO. DRAWING NO.	SHEET
DRAWN BY	APPROVED	OF	11
CHECKED BY		DIRECTOR FOR NO.	OF
			24

SAFETY PAYS

PLATE 11



## VALUE ENGINEERING PAYS

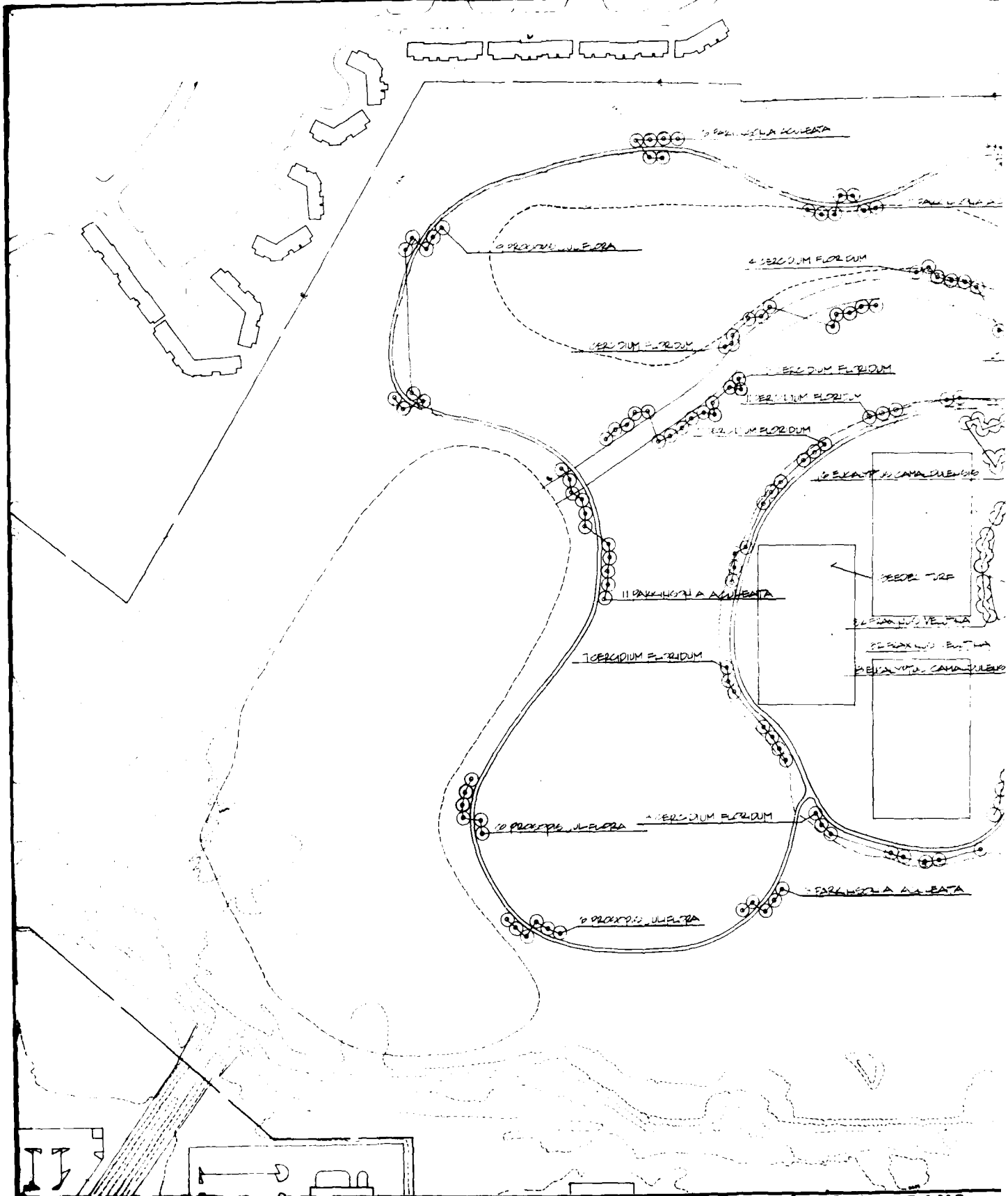


## SAFETY PAYS

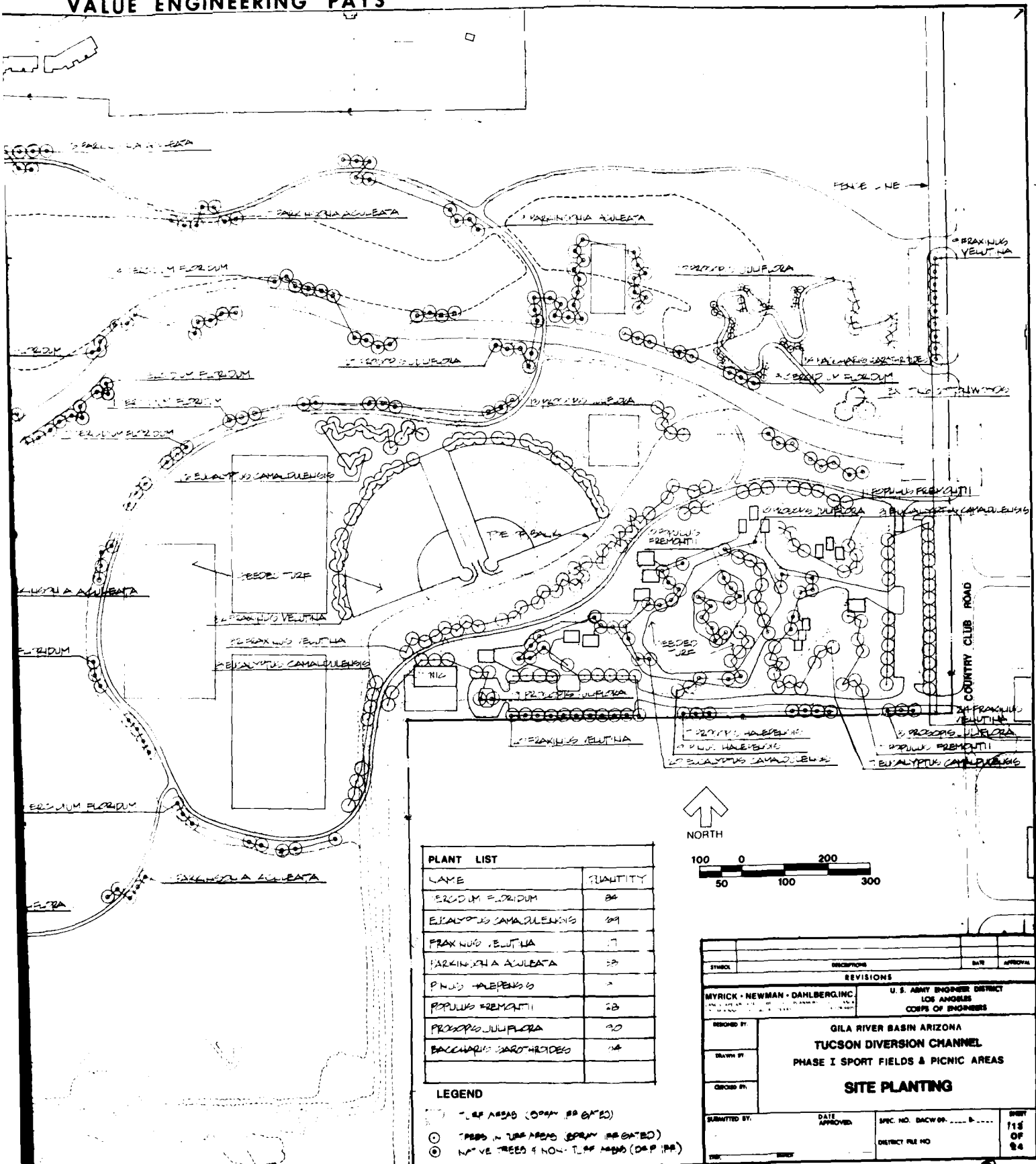
**PLATE 12**

2

ENVIRONMENTAL  
ENHANCEMENT  
THRU ENGINEERING



# VALUE ENGINEERING PAYS



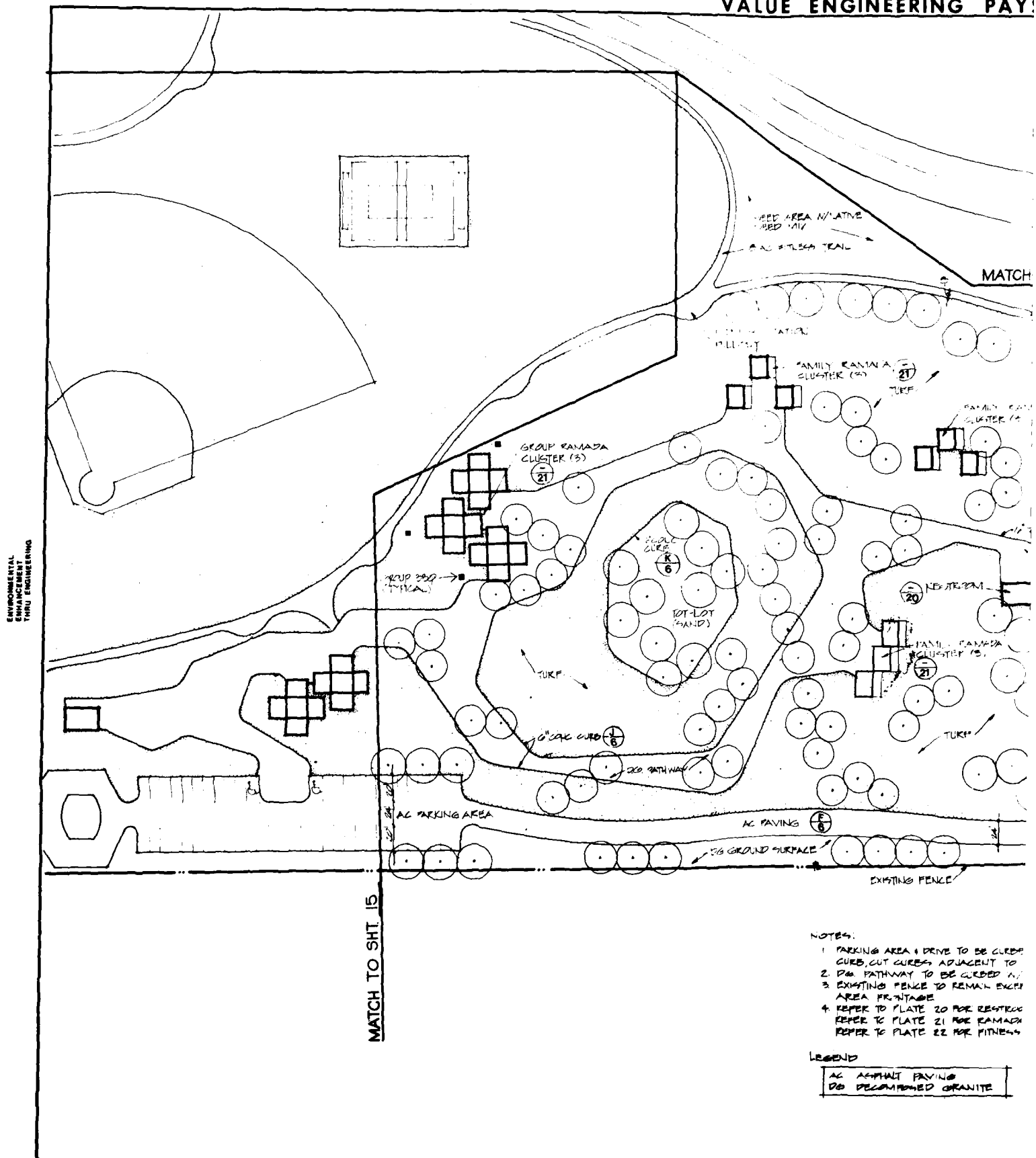
SAFETY PAYS

PLATE 13

SYMBOL		DESCRIPTION		DATE	APPROVAL
REVISIONS					
MYRICK - NEWMAN - DAHLBERG, INC.		U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS			
DESIGNED BY	GILA RIVER BASIN ARIZONA				
DRAWN BY	TUCSON DIVERSION CHANNEL				
CHECKED BY	PHASE I SPORT FIELDS & PICNIC AREAS				
SUBMITTED BY		DATE APPROVED	SPEC. NO. DAWG NO.	SHEET 115 OF 24	
			DISTRICT FILE NO.		

SITE PLANTING

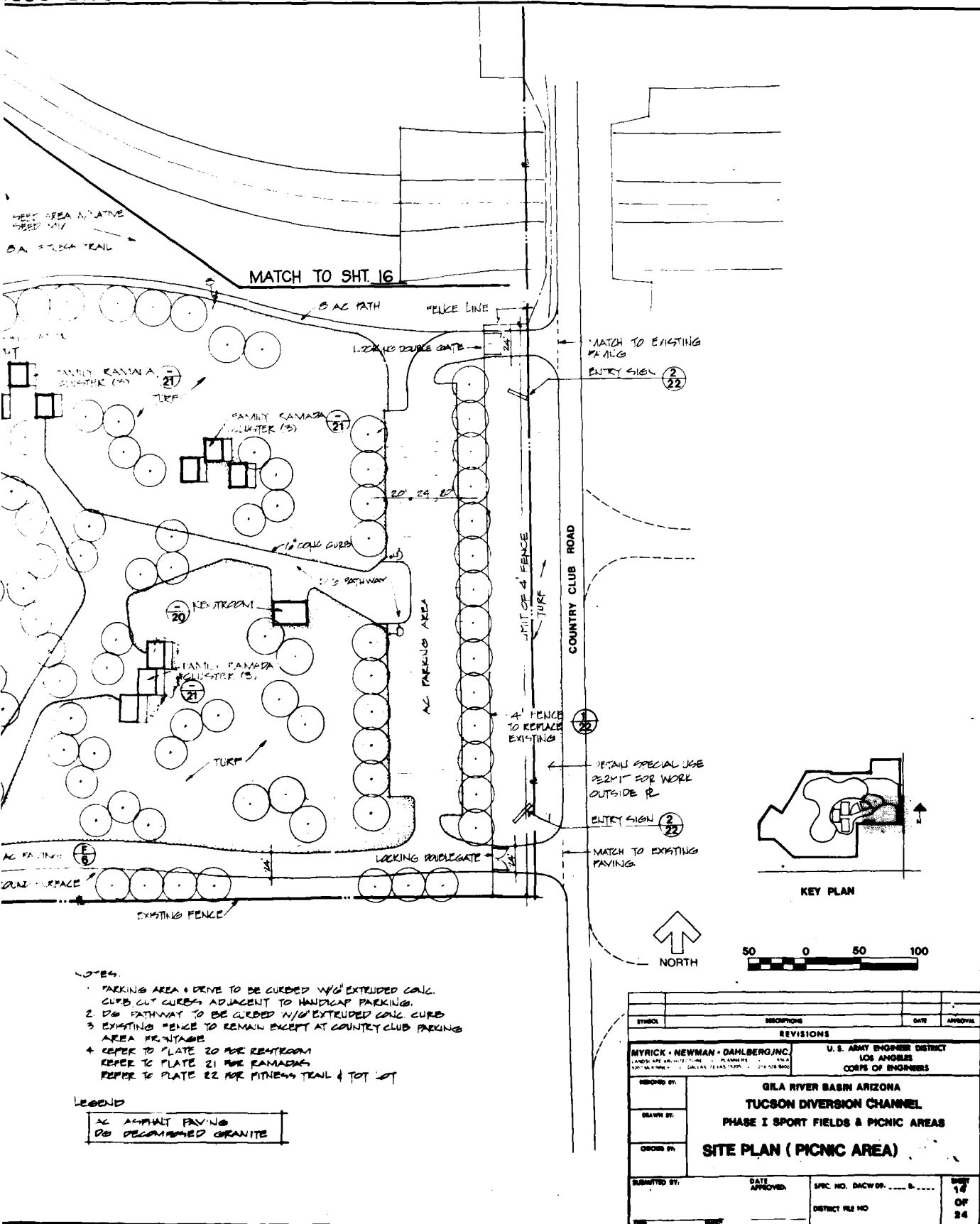
## VALUE ENGINEERING PAYS



## **SAFETY PAYS**



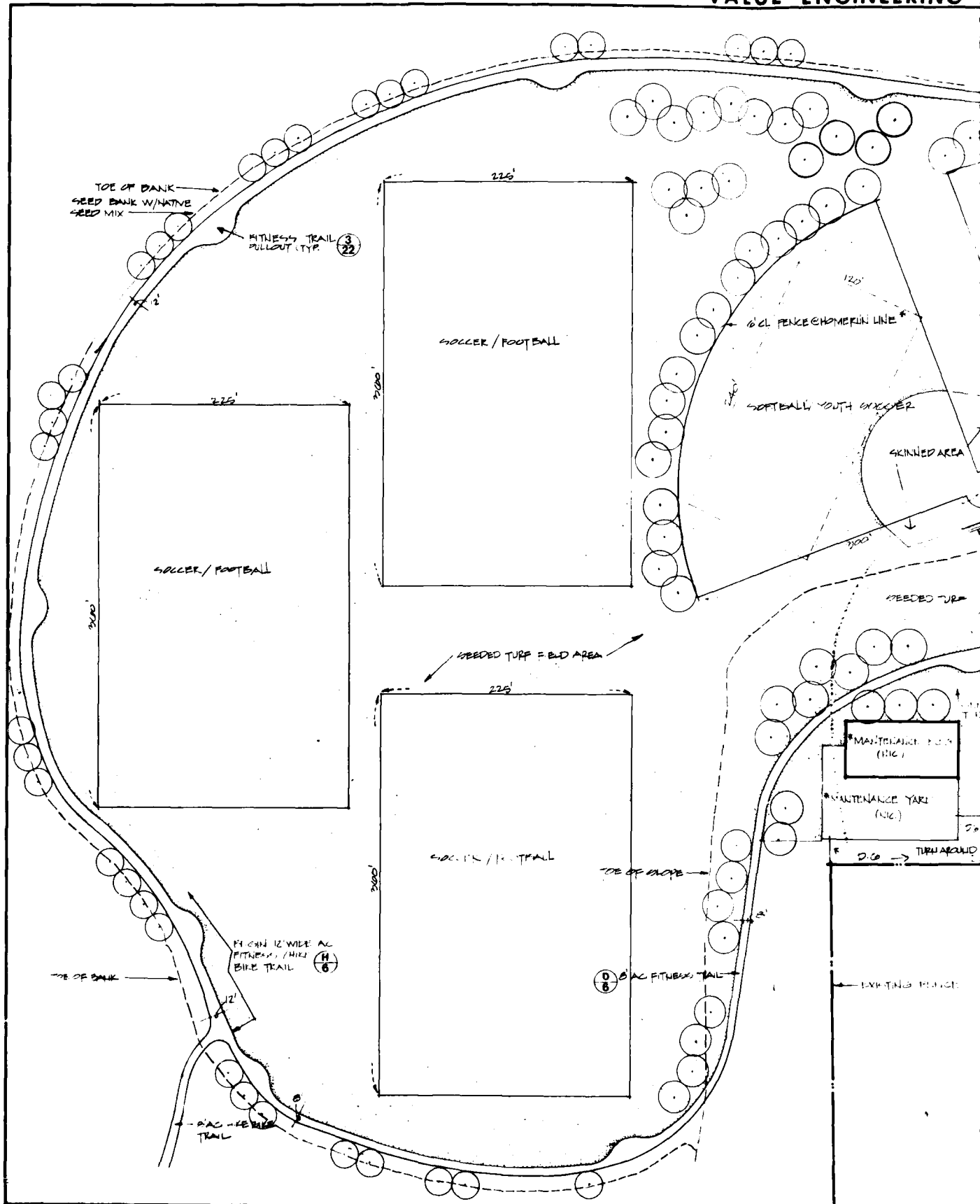
# BLUE ENGINEERING PAYS



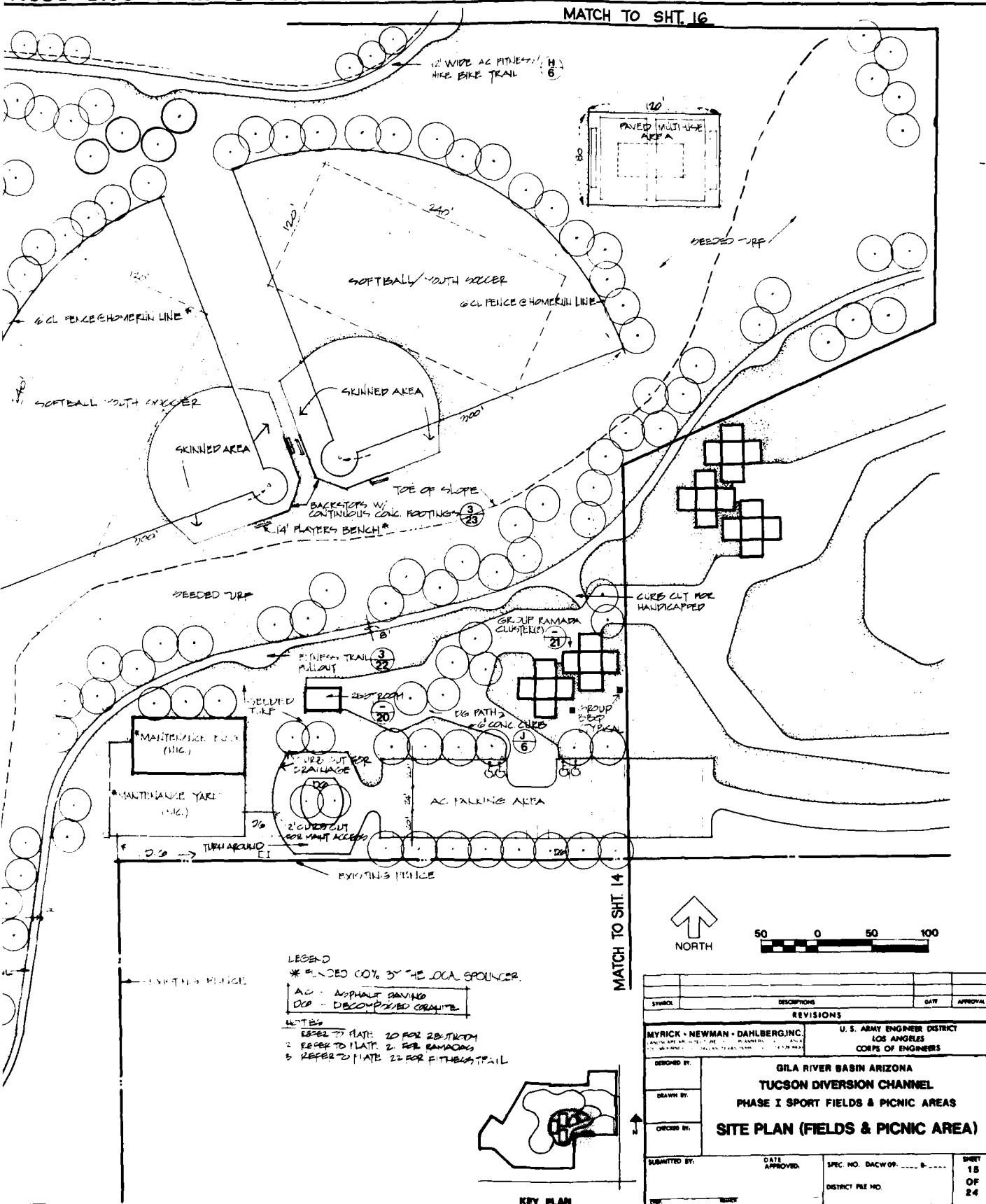
SAFETY PAYS

PLATE 14

ENVIRONMENTAL  
ENHANCEMENT  
THRU ENGINEERING



# VALUE ENGINEERING PAYS



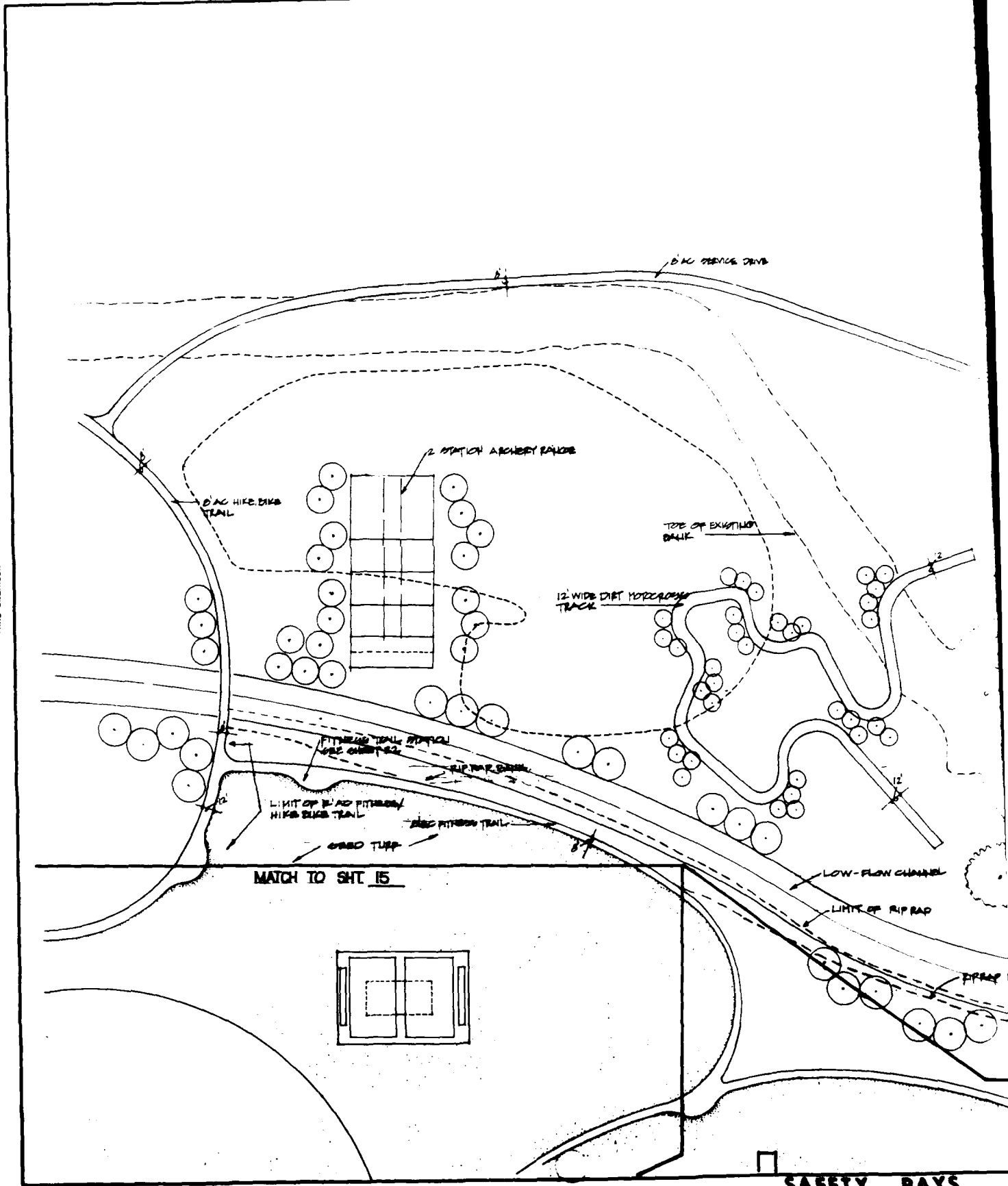
SAFETY PAYS

PLATE 15

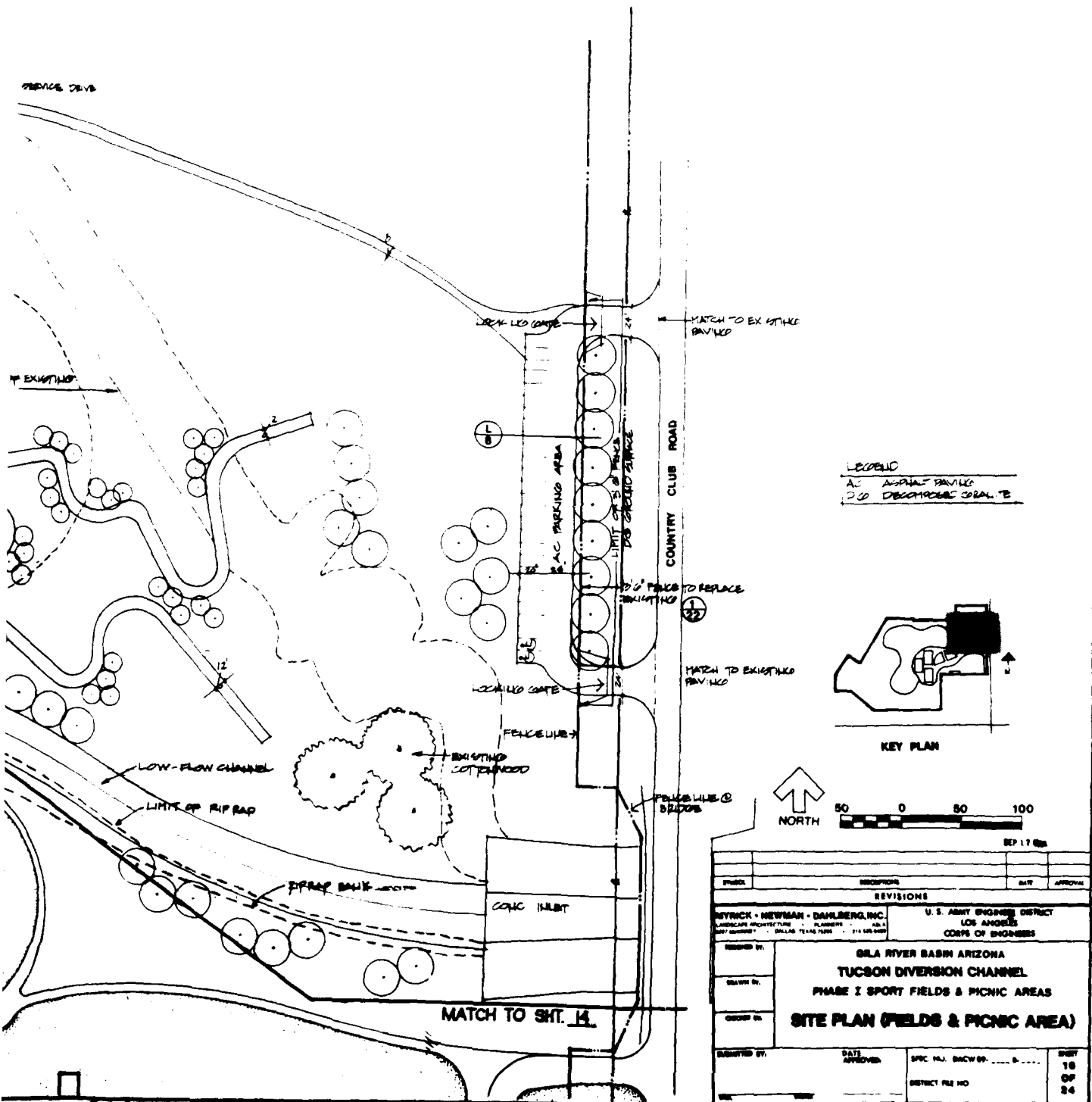
2

SYMBOL	DESCRIPTION	DATE	APPROVAL
<b>REVISIONS</b>			
<b>MYRICK - NEWMAN - DAHLBERG, INC.</b>		<b>U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS</b>	
<b>DESIGNED BY:</b>	<b>GILA RIVER BASIN ARIZONA</b>		
<b>DRAWN BY:</b>	<b>TUCSON DIVERSION CHANNEL</b>		
<b>CHECKED BY:</b>	<b>PHASE I SPORT FIELDS &amp; PICNIC AREAS</b>		
<b>SITE PLAN (FIELDS &amp; PICNIC AREA)</b>			
<b>SUBMITTED BY:</b>	<b>DATE APPROVED:</b>	<b>SPEC. NO. DACW 09- 8- 1</b>	<b>SHEET 15 OF 24</b>
		<b>DISTRICT FILE NO.</b>	

ENVIRONMENTAL  
CONSIDERATIONS  
IN THE DESIGN OF  
TRAILS



# VALUE ENGINEERING PAYS



SAFETY PAYS

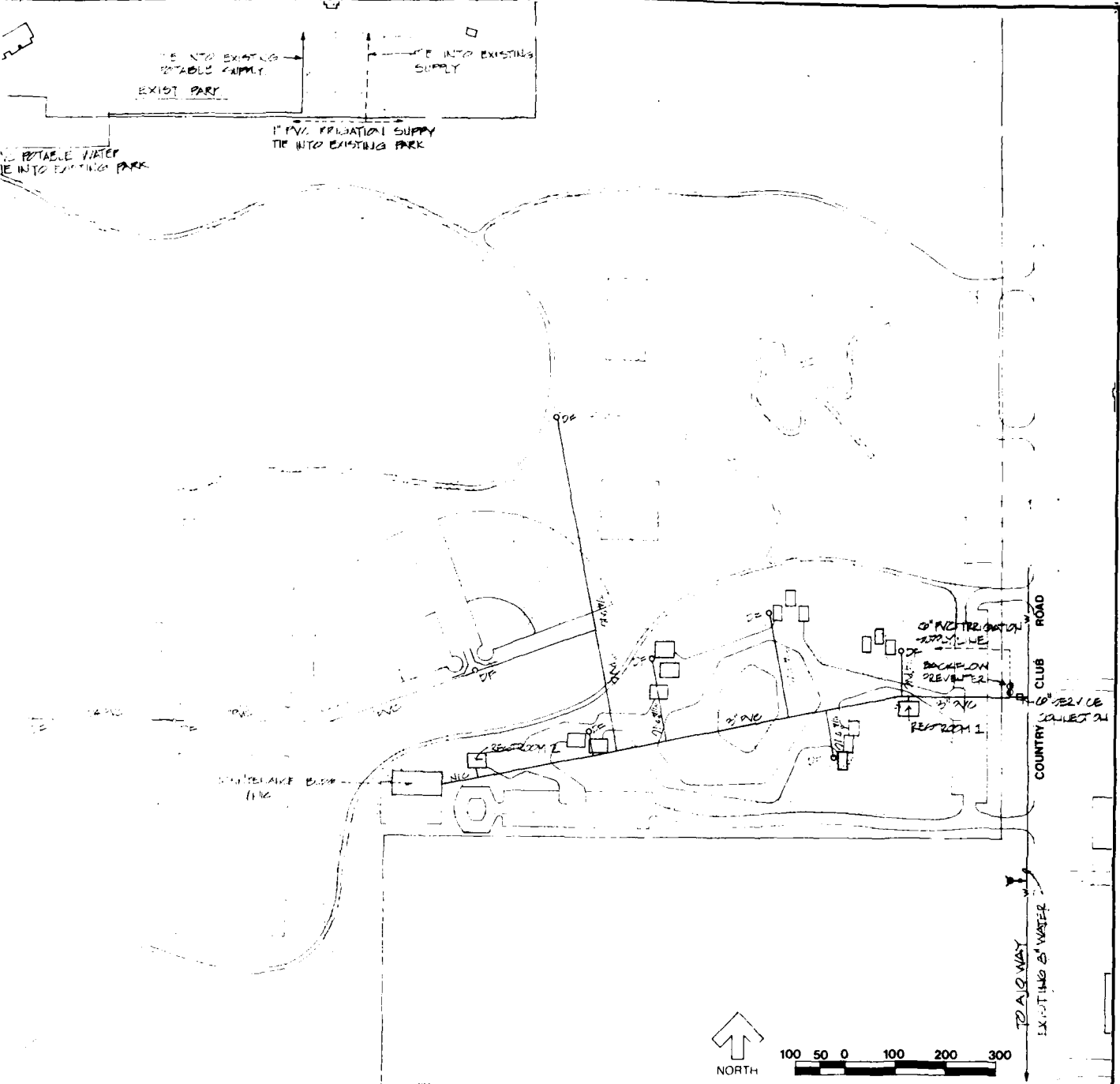
PLATE 16

**ENVIRONMENTAL  
ENHANCEMENT  
THRU ENGINEERING**

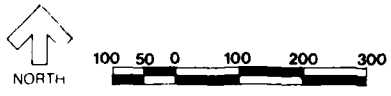
DEVELOPABLE POTABLE WATER  
IN THE EXISTING PARK

## **SAFETY PAYS**

VALUE ENGINEERING PAYS



- NOTES
- 1 SERVICE COLLECTION (METER, BACKFLOW PREVENTER)
  - 2 ROTABLE SUPPLY
  - 3 IRRIGATION SUPPLY
  - 4 DRINKING FOUNTAIN
  - 5 WATER AVAILABLE IN EXISTING 8\"/>
  - 6 COUNTRY CLUB ROAD - 0.5\"/>
  - 7 PEAK DEMAND 15 ACRES TURF 1\"/>
  - 8 A 135\"/>
  - 9 B 27\"/>
  - 10 C 8\"/>
  - 11 D 30\"/>
- 7.50 ACRES (SPRAY IRRIGATED)

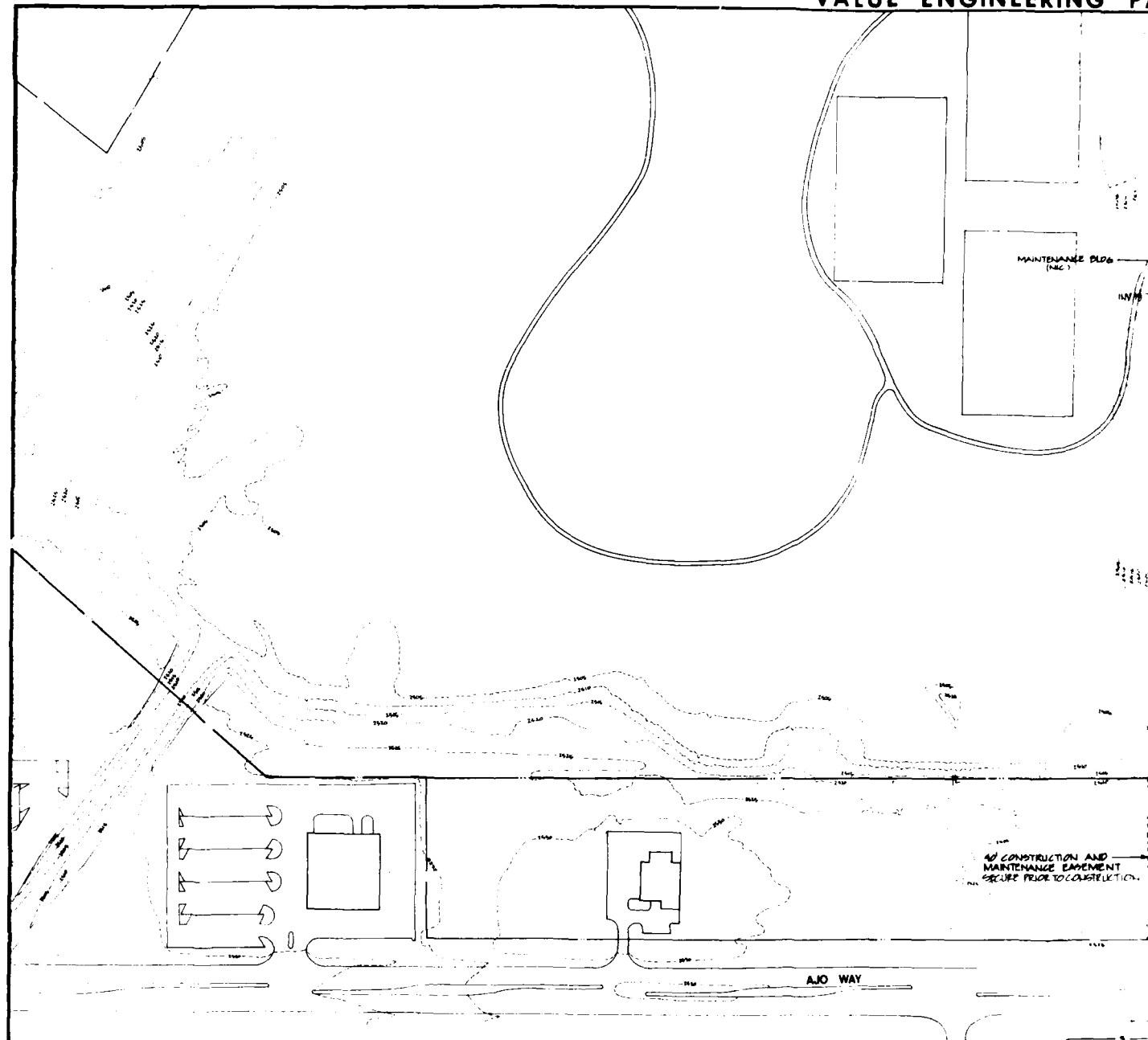


SYMBOL		REVISIONS		DATE	APPROVAL
MYRICK • NEWMAN • DAHLBERG, INC.		U. S. ARMY ENGINEER DISTRICT		LOS ANGELES	
DESIGNED BY		CORPS OF ENGINEERS			
DRAWN BY		GILA RIVER BASIN ARIZONA			
CHECKED BY		TUCSON DIVERSION CHANNEL			
SUBMITTED BY		PHASE I SPORT FIELDS & PICNIC AREAS			
DATE APPROVED		SITE IRRIGATION & DOMESTIC WATER			
SPEC NO. DACW 09-..... B-.....		DISTRICT FILE NO.		SHEET 17 OF 24	

SAFETY PAYS

2

ENVIRONMENTAL  
ENHANCEMENT  
THRU ENGINEERING



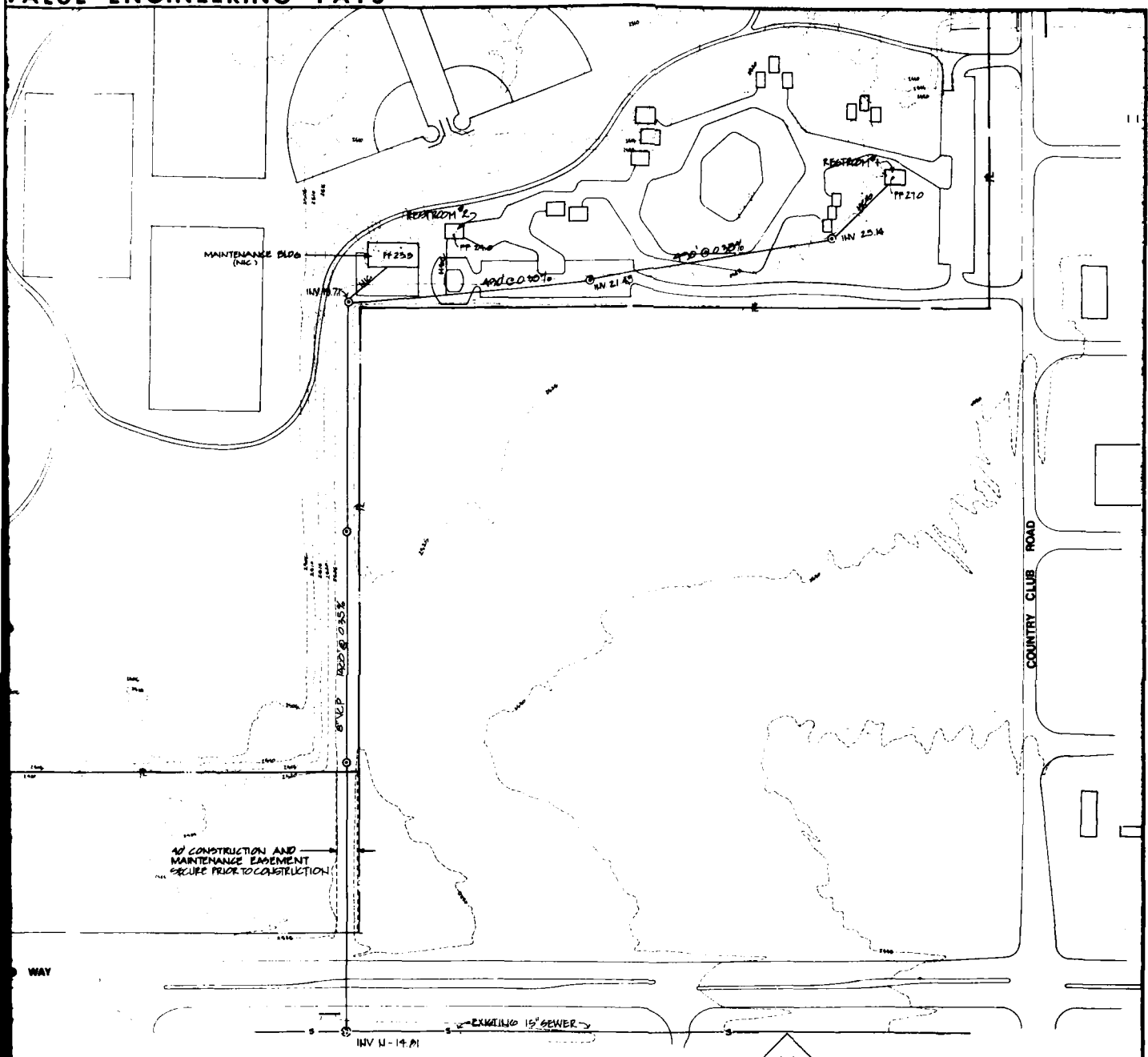
NOTES:

1. SEWER TO BE DESIGNED TO PIMA COUNTY STANDARDS
2. SEWER TO BE TIED INTO EXISTING SEWER MAINWAY
3. ALL SEWER TO BE 8" DIA EXCEPT 4" DIA
4. MANHOLE TO BE CONSTRUCTED 11' DIA 8' DIA MAX OR AS CHANGED BY DIRECTOR
5. MANHOLE TO BE CONSTRUCTED ACCORDING TO PIMA COUNTY SPECIFICATIONS.

SEE SHEET  
 (1) SAN  
 (2) EX  
 (3) V.C.  
 (4) H.C.



# VALUE ENGINEERING PAYS



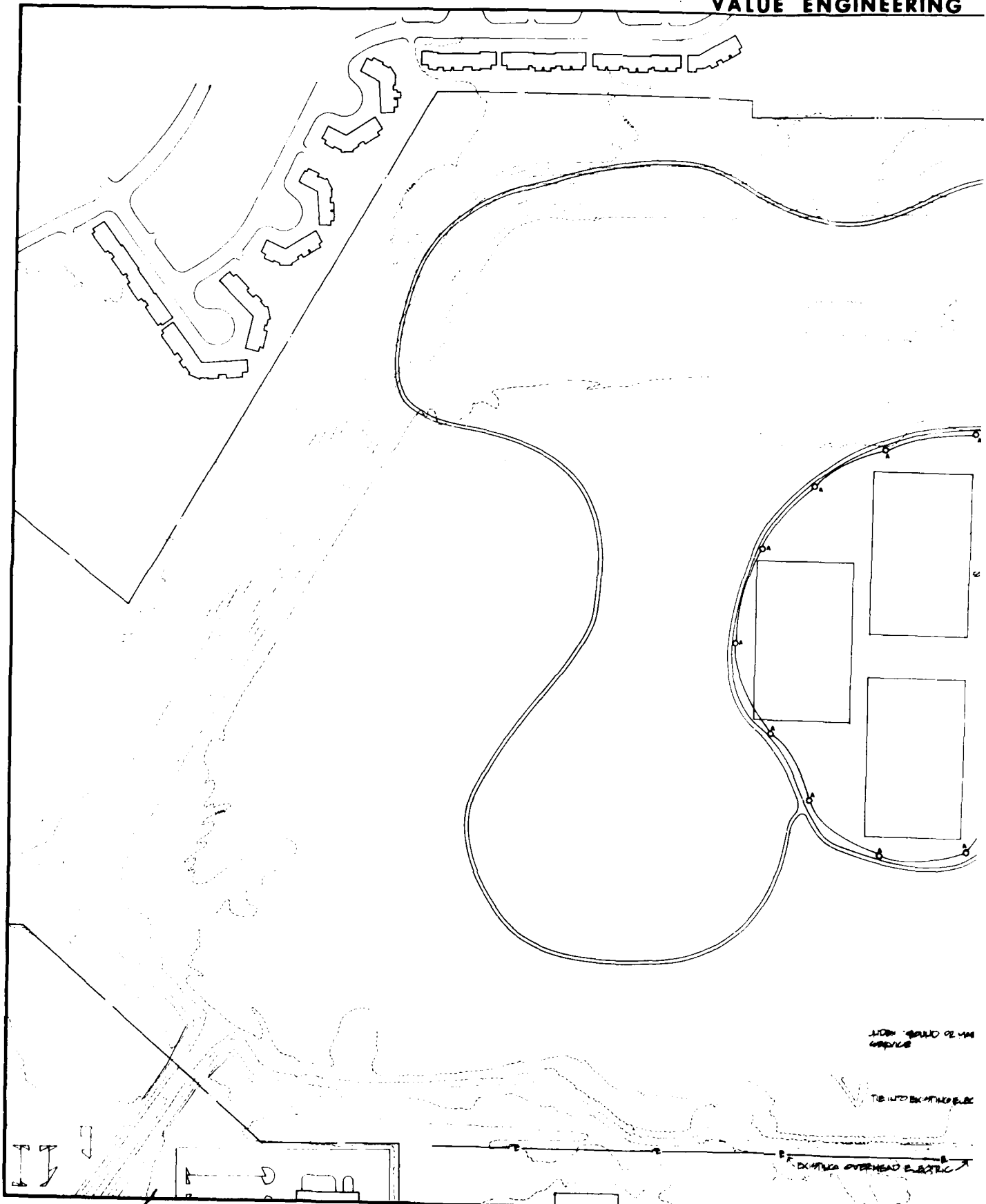
- LEGEND
- VALVE
  - ⊙ EXISTING VALVE
  - ⊙ 12\"/>

SYMBOL		DESCRIPTION		DATE	APPROVAL
REVISIONS					
DESIGNED BY:		MYRICK - NEWMAN - DAHLBERG, INC. U.S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS			
DRAWN BY:		GILA RIVER BASIN ARIZONA TUCSON DIVERSION CHANNEL PHASE I SPORT FIELDS & PICNIC AREAS <b>SEWER</b>			
CHECKED BY:					
SUBMITTED BY:		DATE APPROVED:	SPEC. NO. DAWG NO.:	SHEET 18 OF 24	
			DISTRICT FILE NO.		

# SAFETY PAYS

# VALUE ENGINEERING

ENVIRONMENTAL  
ENHANCEMENT  
THRU ENGINEERING



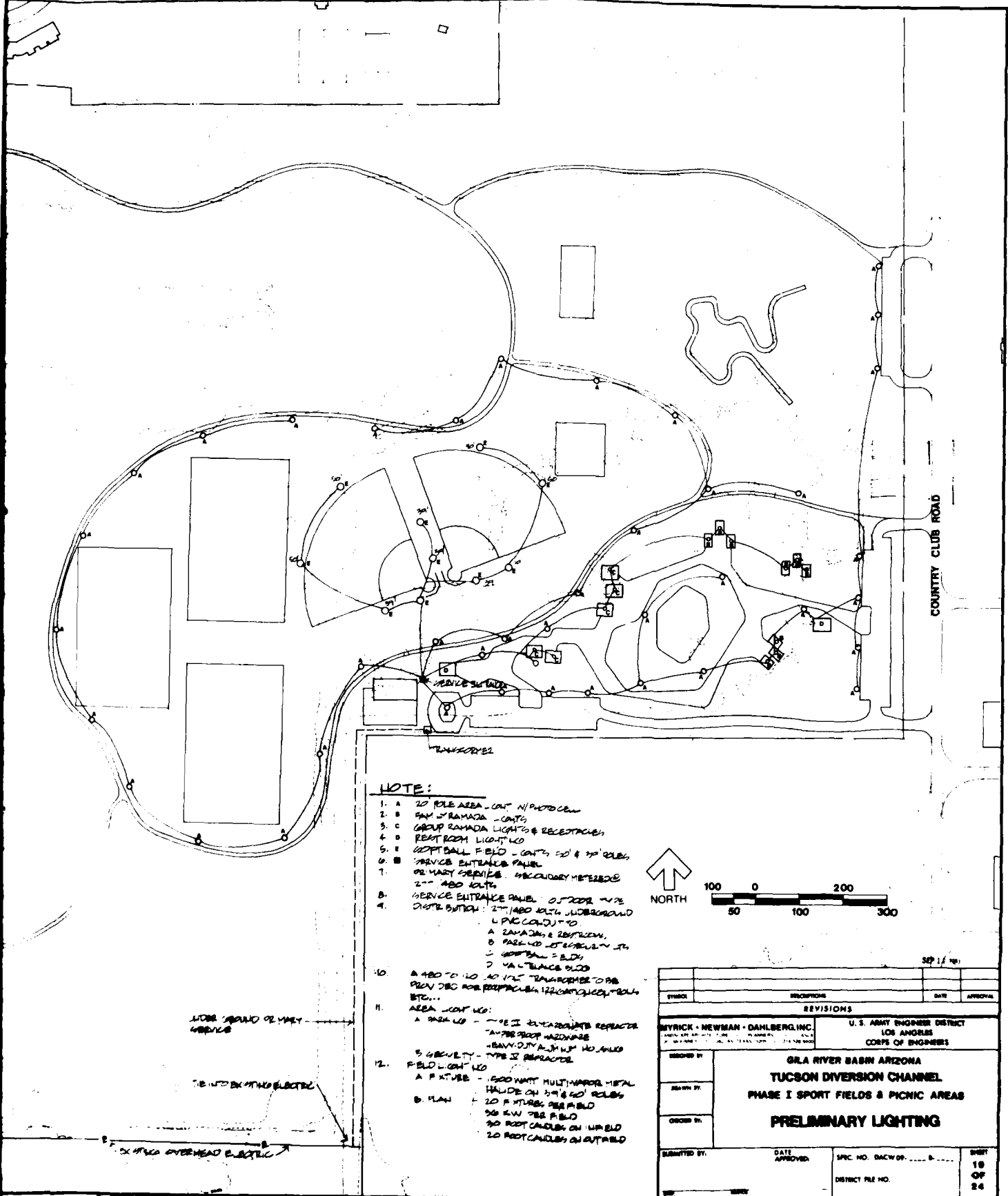
1100' - 1200' OF VMS  
WORKING

TIE INTO EXISTING ELEC

EXISTING OVERHEAD ELECTRIC

## SAFETY PAYS

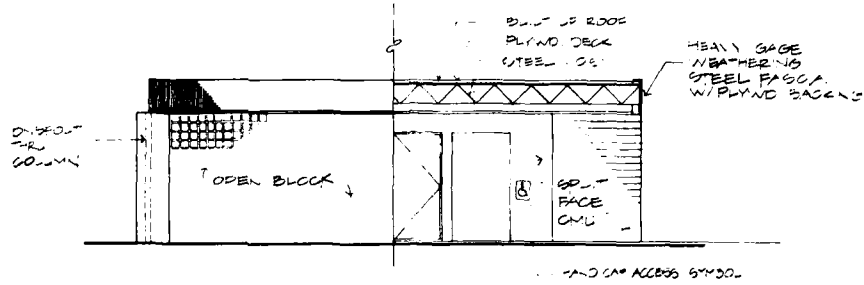
# VALUE ENGINEERING PAYS



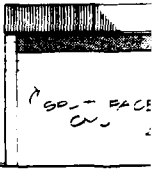
SAFETY PAYS

PLATE 18

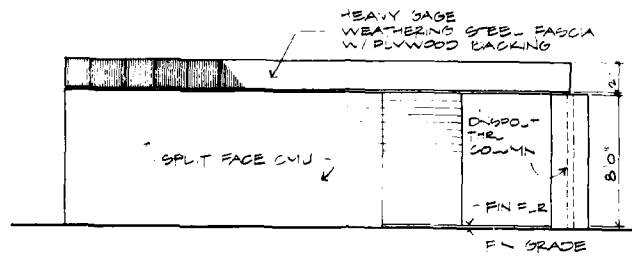
2



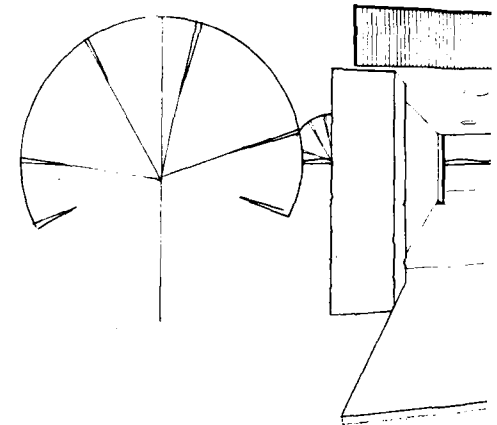
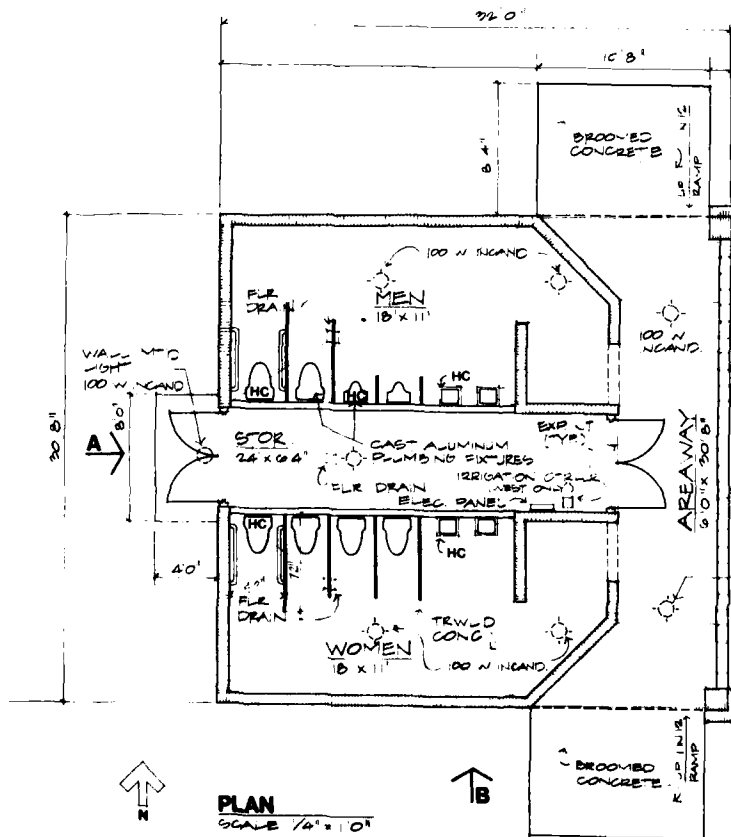
ELEVATION C



ELEVATION A

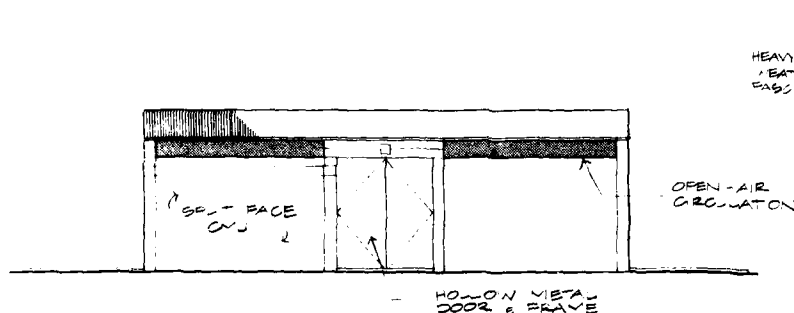


ELEVATION B

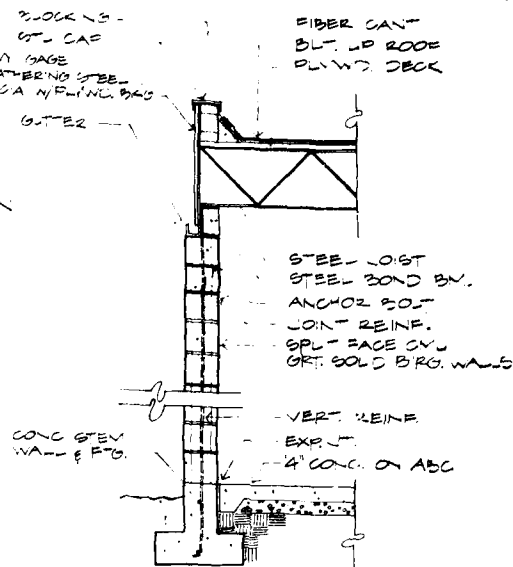


PERSPECTIVE

# ALUE ENGINEERING PAYS

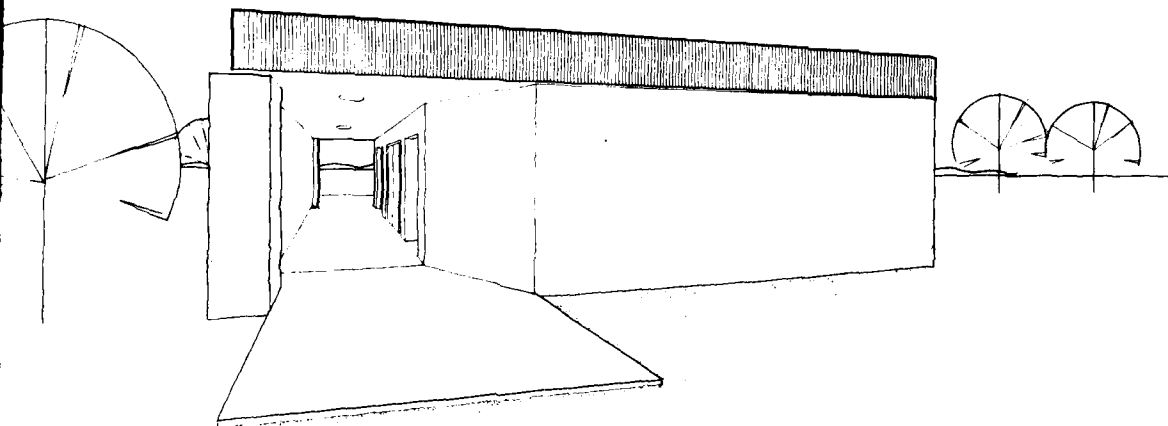


**ELEVATION A**

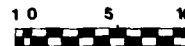


**WALL SECTION**

SCALE 1/4" = 1'-0"

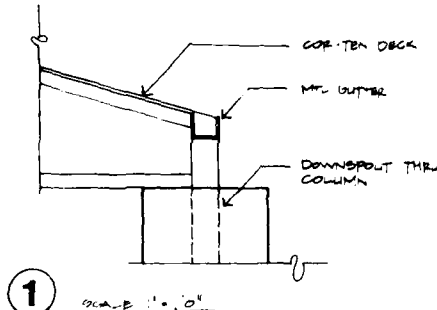


**PERSPECTIVE**

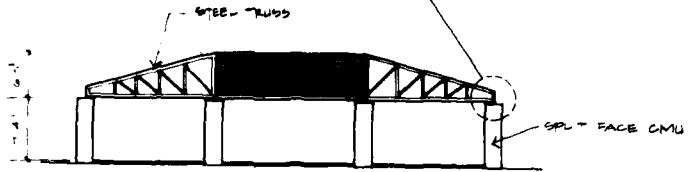


SYMBOL	DESCRIPTION	DATE	APPROVAL
REVISIONS			
U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS			
DESIGNED BY:	GILA RIVER BASIN ARIZONA TUCSON DIVERSION CHANNEL PHASE I SPORT FIELDS & PICNIC AREAS <b>RESTROOMS</b>		
DRAWN BY:			
CHECKED BY:			
SUBMITTED BY:	DATE APPROVED:	SPEC. NO. DACW 09-... B. ....	SHEET 20 OF 24
		DISTRICT FILE NO.	

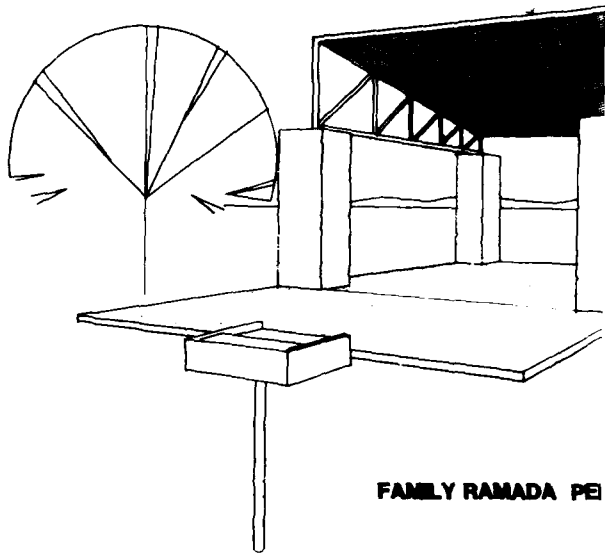
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ENHANCEMENT  
THRU ENGINEERING



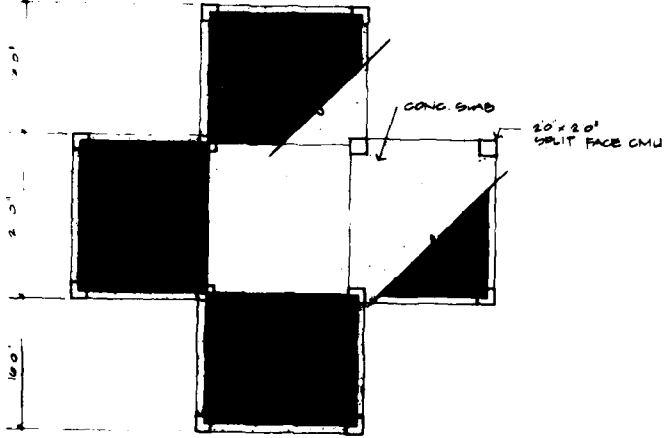
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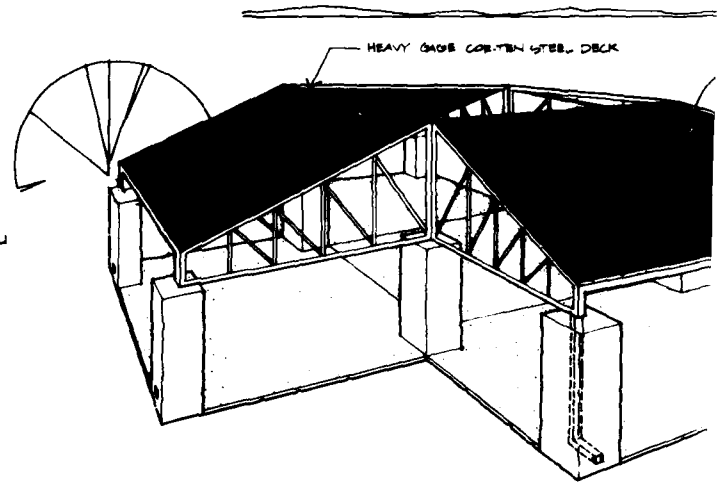
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FAMILY RAMADA PERP

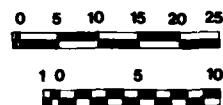
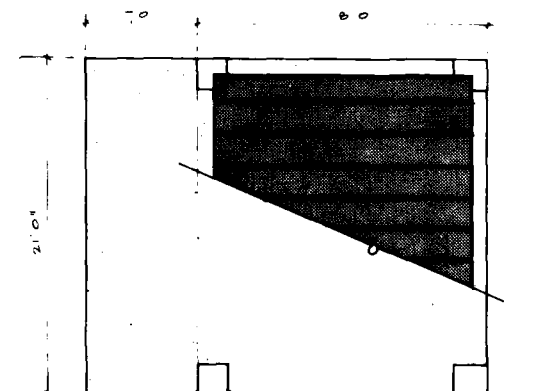
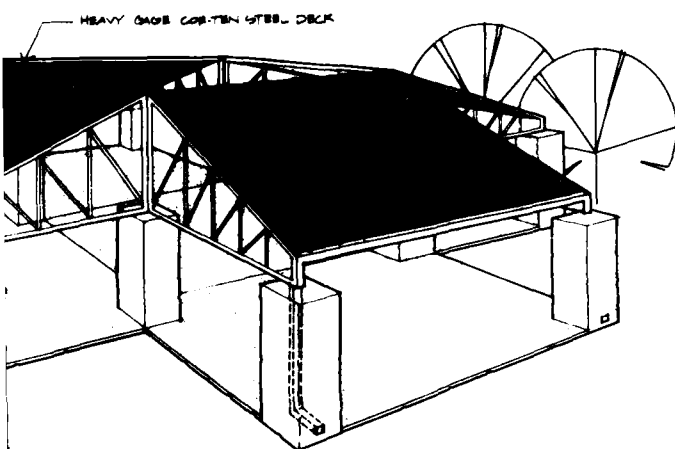
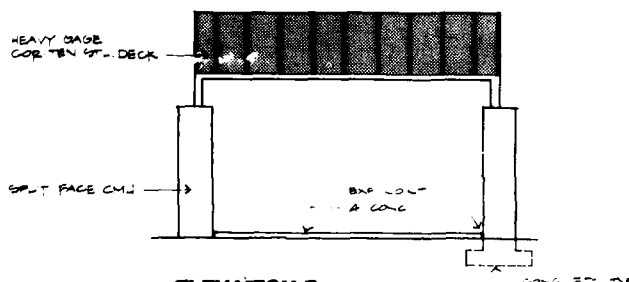
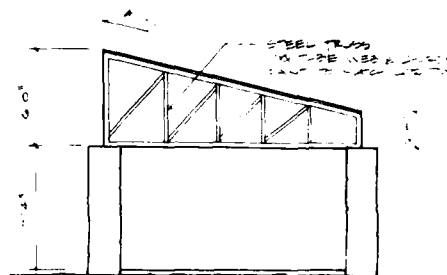
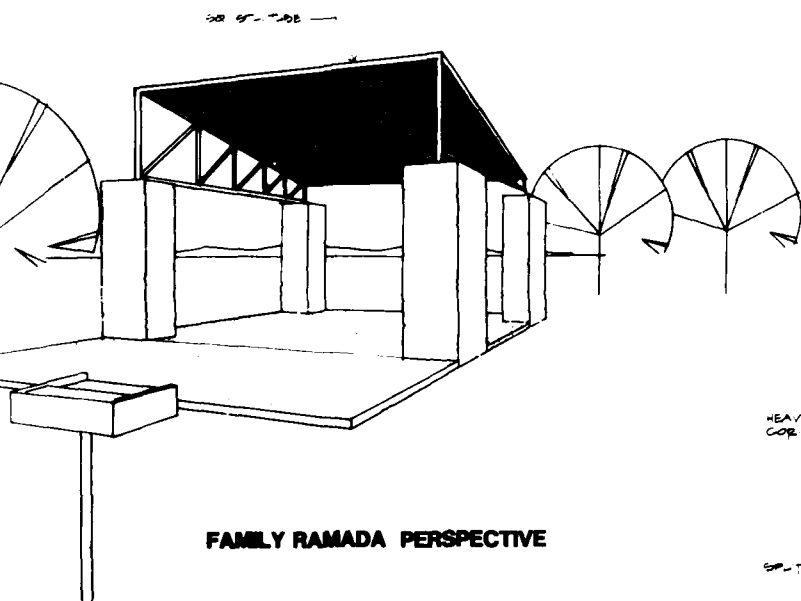


PLAN  
SCALE 1/8" = 1'-0"



GROUP RAMADA PERSP

# ALUE ENGINEERING PAYS

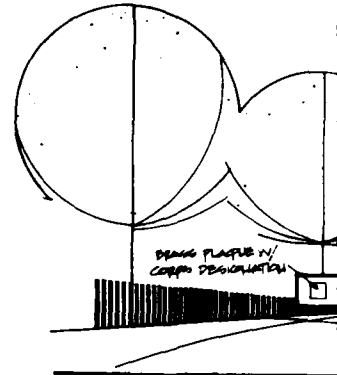
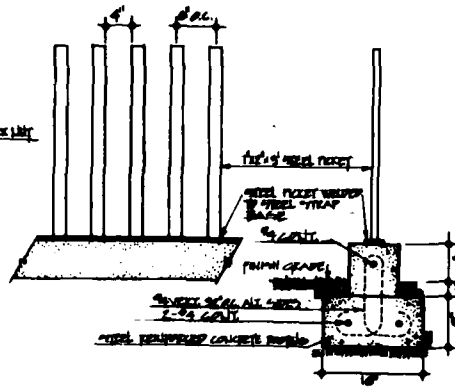


**GROUP RAMADA PERSPECTIVE**

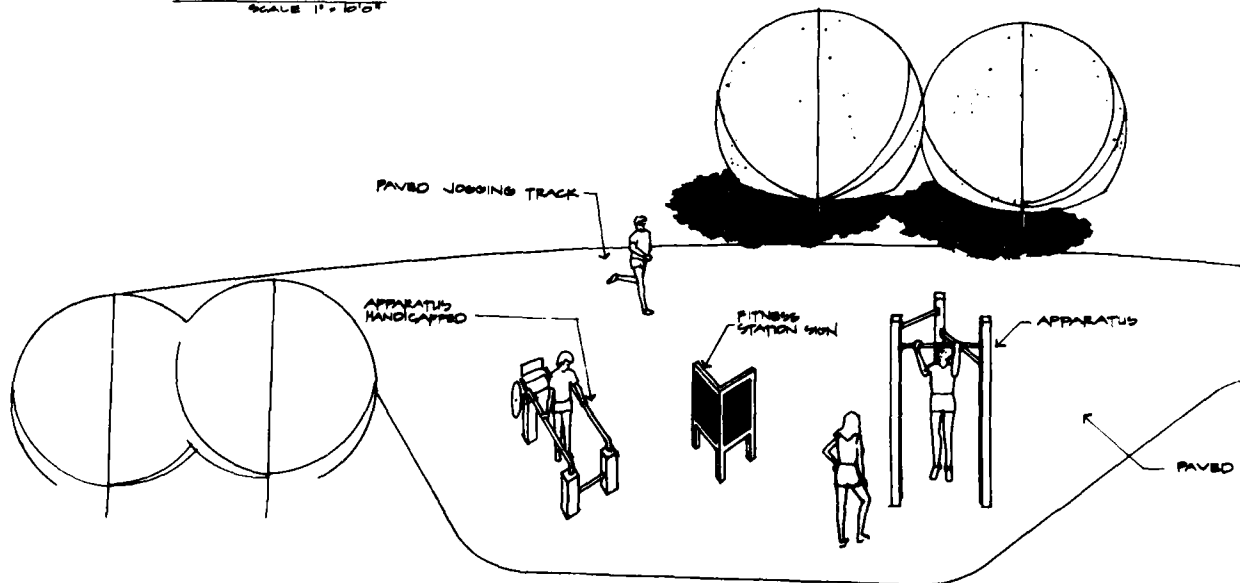
**SAFETY PAYS**

REVISIONS		DATE	APPROVAL
BYRICK • NEWMAN • DANIELSON, INC. LANDSCAPE ARCHITECTURE • PLANNERS 4814 EAST WILLOW • DULLES, TEXAS 75901 • 214 426 1000		U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS	
DESIGNED BY:	GILA RIVER BASIN ARIZONA TUCSON DIVERSION CHANNEL PHASE I SPORT FIELDS & PICNIC AREAS <b>RAMADAS</b>		
DRAWN BY:			
CHECKED BY:			
SUBMITTED BY:	DATE APPROVED	SPEC. NO. DRAWN BY: _____	SHEET 21 OF 24
DESIGNER		DISTRICT FILE NO.	

**PLATE 21**



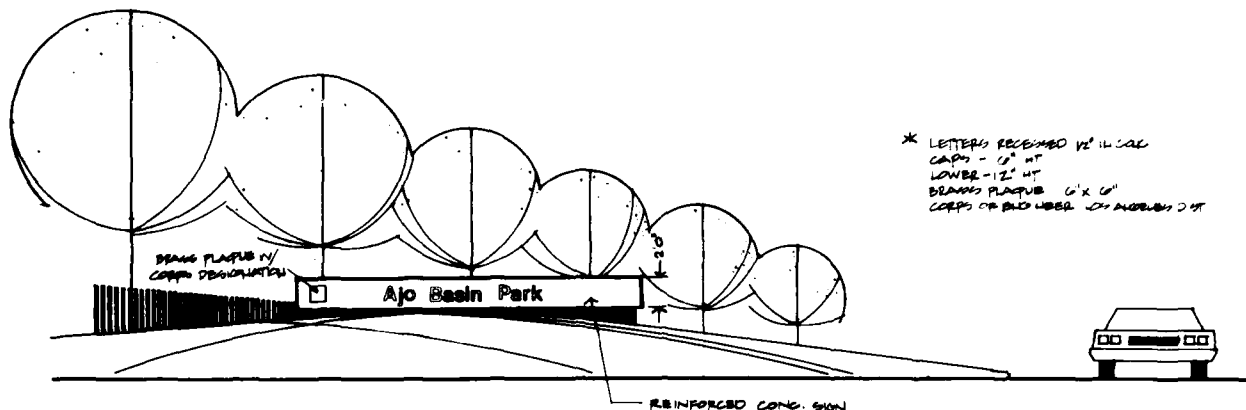
HTS



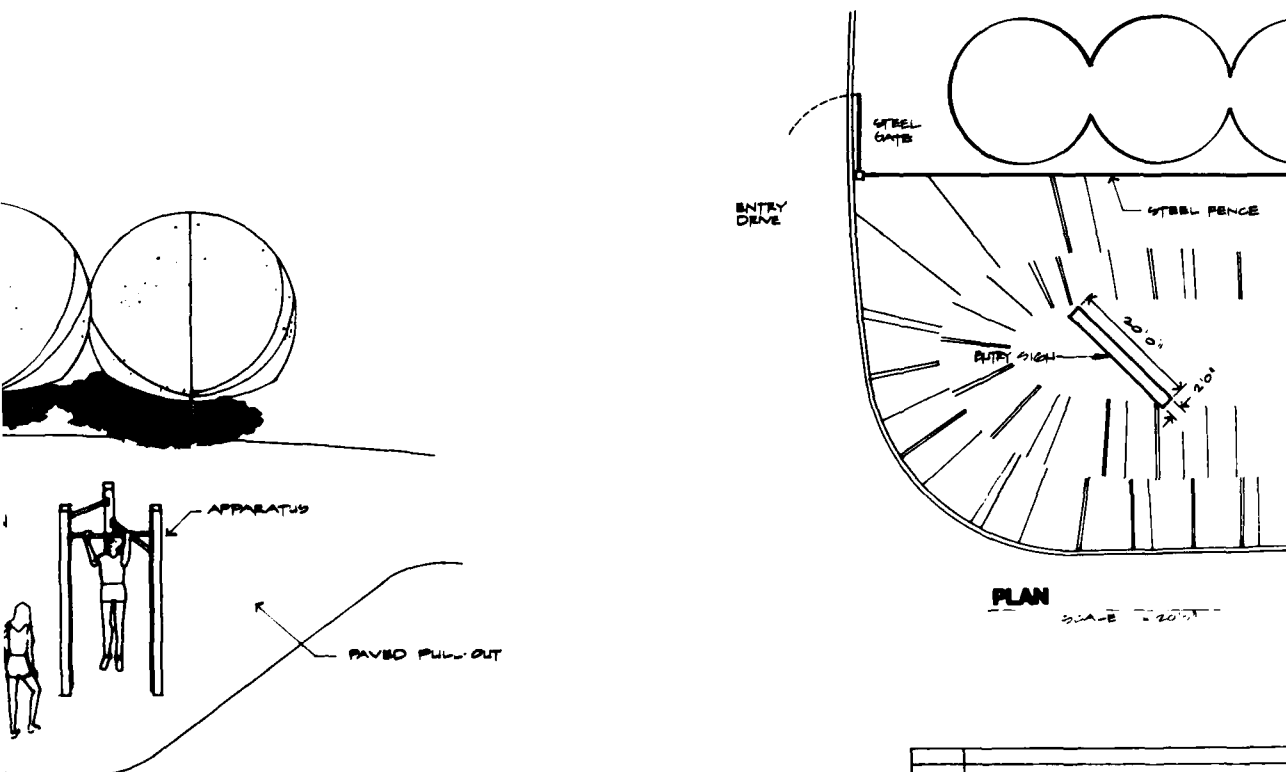
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# VALUE ENGINEERING PAYS

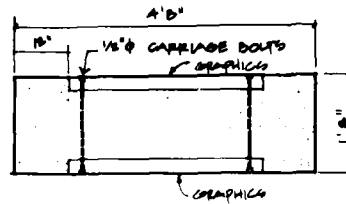


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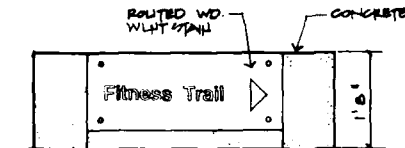


## SAFETY PAYS

REVISED BY		DATE	APPROVED
REVISIONS			
BYRICK - NEWMAN - DAHLBERG		U. S. ARMY ENGINEER DISTRICT	
LARGE SCALE ARCHITECTURE, PLANNING, ETC.		LOS ANGELES	
307 MURPHY - DALLAS, TEXAS 75201 - 714 355 9400		CORPS OF ENGINEERS	
GILA RIVER BASIN, ARIZONA			
TUCSON DIVERSION CHANNEL			
PHASE I SPORT FIELDS & PICNIC AREAS			
FITNESS TRAIL DETAIL & ENTRY SIGN			
DESIGNED BY	DATE APPROVED	SPEC. NO. DRAWING NO.	SHEET NO.
			22 OF 24
DISTRICT FILE NO.			



\* LETTER HEIGHT:  
CAPS - 4"  
LOWERS - 3"  
LETTER RAISED & PAINTED LT BLUE



REFER TO SHEET #3  
FOR SIGN LOCATIONS

# 1 TYPICAL DIRECTIONAL SIGN

HTS

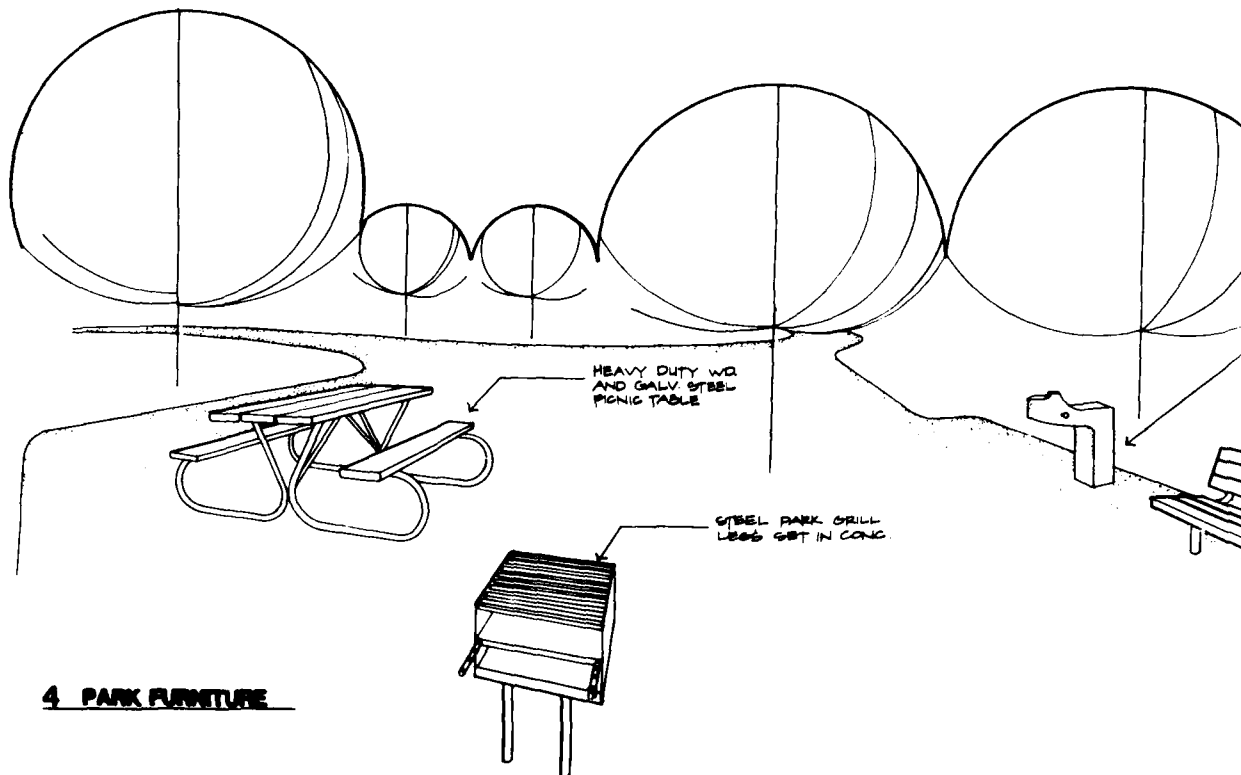
SIGN SCHEDULE	
A	SPORT FIELD/PICNIC AREA
B	FITNESS TRAIL START/FINISH 3/4 MILE
C	FITNESS TRAIL MIDPOINT 3/8 MILE
D	HIKE/BIKE TRAIL START/FINISH 1.2 MILES
E	HIKE/BIKE TRAIL MIDPOINT 0.6 MILES
F	MOTORCROSS/ARCHERY

SECTION

## 2 DRIP IRRIGATION

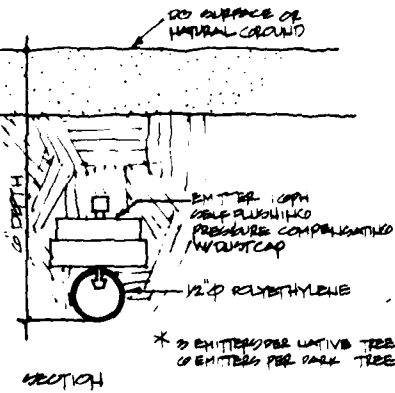
HTS

ENVIRONMENTAL  
ENHANCEMENT  
VALUE ENGINEERING

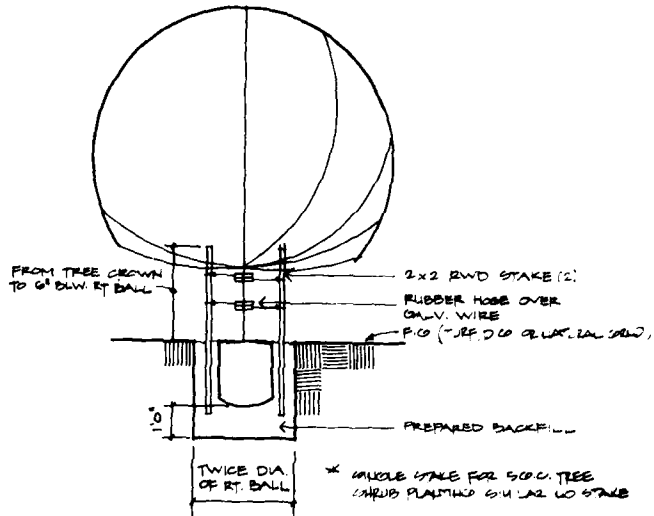


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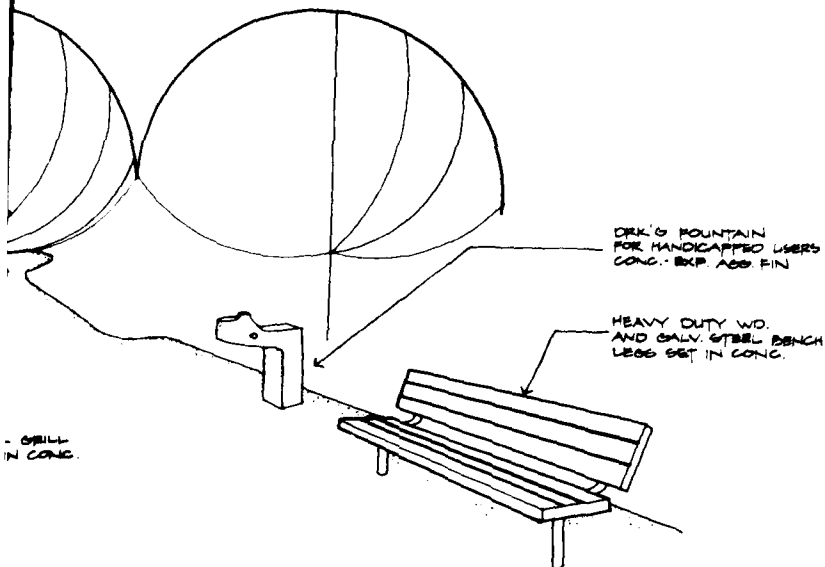
## VALUE ENGINEERING PAYS



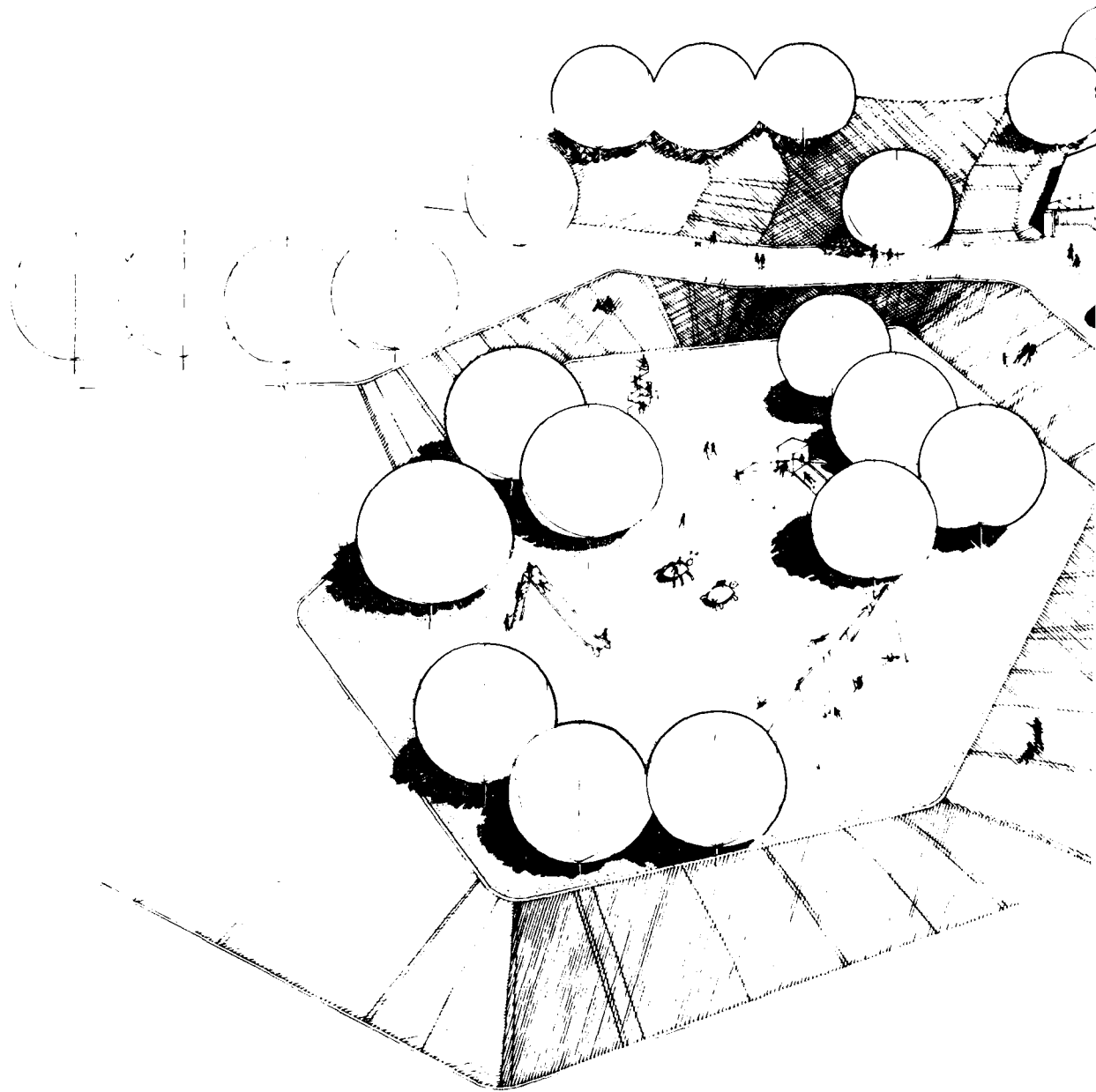
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### 3 PLANTING DETAIL

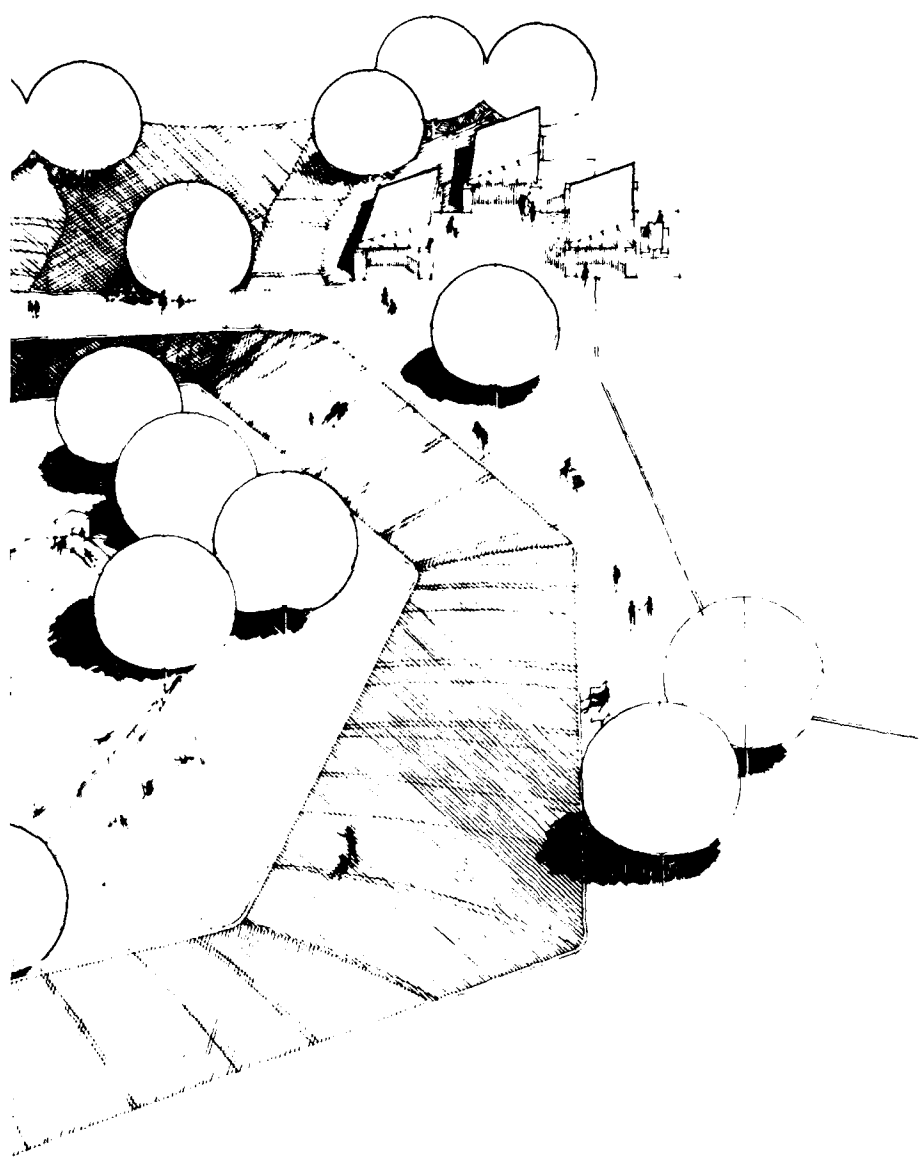


		SEP 11 1961	
PROJECT	DESCRIPTION	DATE	APPROVAL
<b>REVISIONS</b>			
<b>MYRWICK &amp; NEUBAUER &amp; ZAHLBERG INC.</b> LANDSCAPE ARCHITECTURE - PLANNING - DESIGN 1201 NEUBAUER - GILLESPIE - 10 EAST "LAKESIDE" - LOS ANGELES		<b>U. S. ARMY ENGINEER DISTRICT</b> <b>LOS ANGELES</b> <b>CORPS OF ENGINEERS</b>	
DESIGNED BY	GILA RIVER BASIN ARIZONA TUCSON DIVISION CHANNEL PHASE I SPORT FIELDS & PICNIC AREAS <b>SIGNAGE , PARK FURNITURE</b> <b>&amp; PLANTING DETAILS</b>		
DESIGNED BY			
DESIGNED BY			
APPROVED BY	DATE APPROVED	SPC. NO. DRAWING NO. _____	SHEET NO. _____ OF _____
DATE APPROVED			



ENVIRONMENTAL  
DESIGN  
PARKS & RECREATION

# VALUE ENGINEERING PAYS



SEP 17 1971			
DESIGNED BY	DATE	REVISIONS	APPROVAL
SERVICE - NEWMAN - DAHLBERG INC. LANDSCAPE ARCHITECTURE 3827 KENTMERE • DALLAS, TEXAS 75219 • 214 352 7840		U. S. ARMY INDOOR DISTRICT LOS ANGELES CORPS OF ENGINEERS	
DESIGNED BY	GILA RIVER BASIN ARIZONA TUCSON DIVERSION CHANNEL PHASE I SPORT FIELDS & PICNIC AREAS TOT LOT		
DATE			
APPROVAL			
SUBMITTED BY	DATE	SPEC. NO. DRAWN BY	SHEET
		DISTRICT FILE NO.	24 OF 24

SAFETY PAYS

PLATE 24

2

**APPENDIX B**

**COST ESTIMATES**

FDM ESTIMATE  
TUCSON DIVERSION CHANNEL  
SPORT FIELDS

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
1.	Grading	98,361	CY	\$1.50	\$147,541.00
2.	Clearing and Grubbing	718,740	SF	.04	28,750.00
3.	Seeded Turf	718,740	SF	.12	86,250.00
4.	Turf Irrigation	718,740	SF	.20	143,750.00
5.	Trees 5 Gallon Container	93	Each	25.44	2,366.00
6.	Drinking Fountains	4	Each	550.00	2,200.00
7.	Water Service	1,800	LF	1.50	2,700.00
8.	Multi-Purpose Court Concrete, Acrylic Surface	9,600	SF	3.06	29,380.00
9.	Backstops	2	Each	4,500.00	9,000.00
10.	Football Soccer Goals	6	Each	600.00	3,600.00
11.	Field Lighting (Softball)		LS	70,000.00	70,000.00
12.	Security Lighting <sup>1</sup> (Pole)	17	Each	1,800.00	30,600.00
13.	Trash Receptacles	3	Each	75.00	225.00 <sup>2</sup>
14.	Benches (Softball)	4	Each	400.00	1,600.00
15.	Basketball Goals (Set)	2	Each	1,500.00	3,000.00

SUBTOTAL

\$561,000.00

<sup>1</sup>Includes Distribution Costs

<sup>2</sup>Not Cost Shareable

FDM ESTIMATE  
TUCSON DIVERSION CHANNEL  
PICNIC AREA

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
1.	Grading	8,067	CY	\$1.50	\$12,100.00
2.	Clearing and Grubbing	435,600	SF	.04	17,424.00
3.	Seeded Turf	230,868	SF	.12	27,704.00
4.	Decomposed Granite	63,000	SF	.25	15,750.00
5.	Trees 15 Gallon Container	114	Each	73.85	8,419.90
6.	Turf Irrigation	230,868	SF	.20	46,174.00
7.	Drip Irrigation		LS		2,100.00
8.	Tot Lot				
	Play Equipment		LS		6,500.00
	Sand	27	CY	8.00	2,200.00
9.	Restrooms	2			
	Foundation	14	CY	172.51	2,415.00
	Slab	1,920	SF	1.58	3,033.00
	Walls	2,470	SF	8.34	20,599.00
	Roof	1,920	SF	2.50	4,800.00
	Fascia	180	SF	10.00	1,800.00
	Toilets (W.C.)	12	Each	554.00	6,648.00
	Urinals	4	Each	682.00	2,728.00
	Lavatory	8	Each	458.00	3,664.00
	Partitions	16	Each	245.00	3,920.00
	Plumbing	24	Each	770.00	18,480.00
	Electrical	12	Each	500.00	6,000.00
	Interior Walls	1,024	SF	3.50	3,584.00
	Doors	8	Each	200.00	1,600.00
10.	8" VCP (Sewer)	2,380	LF	20.00	47,600.00
11.	4" VCP (HCS)	250	LF	10.00	2,500.00
12.	Manholes	5	Each	1,200.00	6,000.00
13.	6" Water Connection	1	Each	7,300.00	7,300.00
14.	Group Ramada	5	Each		
	Slab	10,500	SF	1.58	16,590.00
	Columns	5,120	SF	8.00	40,960.00
	Roof Trusses	20,880	Lbs.	.58	12,110.00
	Deck (Plywood)	7,500	SF	.47	3,525.00
	Metal Roofing	7,500	SF	10.00	75,000.00
	Steel Tubing	7,500	SF	5.00	37,500.00
	Lighting (Electrical)	40	Each	500.00	20,000.00
15.	Family Ramada	9	Each		
	Slab	4,725	SF	1.58	7,465.00
	Columns	2,304	SF	8.00	18,432.00
	Roof Trusses	9,396	Lbs.	.58	5,450.00
	Deck (Plywood)	3,375	SF	.47	1,586.00
	Metal Roofing	3,375	SF	10.00	33,750.00
	Steel Tubing	3,375	SF	5.00	16,875.00
	Lighting (Electrical)	18	Each	500.00	9,000.00



PICNIC AREA (continued)

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
16.	Picnic Table	54	Each	\$350.00	\$18,900.00
17.	Drinking Fountains	5	Each	550.00	2,750.00
18.	Water Service (Potable)	1,200	LF	2.84	3,408.00
19.	BBQ Grill (Group)	5	Each	850.00	4,250.00
20.	BBQ Grill (Family)	9	Each	75.00	675.00
21.	Service Drive, 1-1/2" A.C.	400	SF	2.85	1,140.00
22.	Curbing Ext. Conc. 6"	6,800	LF	2.25	15,300.00
23.	Electrical <sup>1</sup>				
	Primary Duct	1	Each	5,200.00	5,200.00
	Transformer Pad	100	SF	3.00	300.00
	Service Entrance	1	Each	5,000.00	5,000.00
	Parking & Security Lts.	20	Each	1,800.00	36,000.00
24.	Signage				
	Entry	2	Each	2,500.00	5,000.00
	Directional/Informative	3	Each	800.00	2,400.00
25.	Benches	15	Each	225.00	3,375.00
26.	Trash Receptacles	24	Each	75.00	1,800.00
27.	Remove Exist. Fence	475	LF	.99	470.00
28.	New Fence, 3'-6" Steel	425	LF	15.00	6,375.00
29.	Gates	2	Each	700.00	1,400.00
30.	Parking, 1-1/2" AC	7,750	SY	3.00	23,250.00
SUBTOTAL					\$716,000.00

<sup>1</sup>Includes Distribution Costs

FDM ESTIMATE  
TUCSON DIVERSION CHANNEL  
HIKE/BIKE TRAIL

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
1.	Grading	48,000	SF	\$.07	\$3,360.00
2.	AC Paving 8' x 1-1/2"	5,333	SY	2.85	15,199.00
3.	Drainage Crossing 18" cmp	60	LF	30.00	1,800.00
4.	Drinking Fountain	1	Each	550.00	550.00
5.	Water Service (Potable)	500	LF	1.00	500.00
6.	Signage (Directional)	2	Each	800.00	1,600.00
7.	Trees 5 G.C. Sngl. Stk.	87	Each	25.44	2,213.00
8.	Drip Irrigation		LS		6,000.00
SUBTOTAL					\$32,000.00

FDM ESTIMATE  
TUCSON DIVERSION CHANNEL  
ARCHERY/MOTOCROSS FACILITY

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
1.	Archery				
	Clearing and Grubbing	12,800	SF	\$.04	\$ 512.00
	Trees 5 Gallon Container	19	Each	25.44	483.00
	Drip Irrigation		LS		500.00
2.	Motocross				
	Grading	13,200	SF	.07	924.00
	Clearing and Grubbing	13,200	SF	.04	528.00
	Trees 5 Gallon Container	19	Each	25.44	483.00
	Shrubs 1 Gallon Container	34	Each	7.00	238.00
	Drip Irrigation		LS		3,200.00
	Trash Receptacle	1	Each	75.00	75.00
	Service Road, 1-1/2" AC	1,067	SY	2.85	3,040.00
	Parking, 1-1/2" AC	1,667	SY	3.00	5,001.00
	Curbing, 6" Ext. Conc.	1,000	LF	2.25	2,250.00
	Gates	2	Each	700.00	1,400.00
	Electrical <sup>1</sup>	3	Each	1,800.00	5,400.00
	Signage	1	Each	800.00	800.00
	Fence Removal	400	LF	.99	396.00
	Fence, 3'-6" Steel	350	LF	15.00	5,250.00
	SUBTOTAL				\$30,000.00

<sup>1</sup>Includes Distribution Costs

TUCSON DIVERSION CHANNEL  
FITNESS TRAIL

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
1.	Stations, 18 Comb - Wheel/Standard		LS		\$10,500.00
2.	AC Paving, 1-1/2" AC	2,978	SY	\$2.85	8,487.00
3.	Sign	1	Each	800.00	800.00
4.	Trees, 15 G.C. Db1. Stk.	36	Each	73.85	2,659.00
5.	Drip Irrigation		LS		2,200.00
	SUBTOTAL				\$24,000.00

FDM ESTIMATE  
TUCSON DIVERSION CHANNEL  
LOW-FLOW CHANNEL

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
1.	Grading	8,000	CY	\$1.50	\$12,000.00
2.	Clearing and Grubbing	96,258	SF	.04	3,850.00
3.	Trees 5 G.C. Sngl. Stk.	67	Each	25.44	1,704.00
4.	Drip Irrigation		LS		1,100.00
5.	Grouted Rip-Rap	333	CY	90.00	29,970.00
SUBTOTAL					\$48,000.00

**APPENDIX C**

**GEOTECHNICAL REPORT**

TUCSON DIVERSION CHANNEL  
Phase I - Sports Field and Picnic Area

GEOTECHNICAL REPORT

APPENDIX C  
To Feature Design Memorandum

LOS ANGELES DISTRICT  
February 1983

TUCSON DIVERSION CHANNEL  
Phase I - Sports Fields and Picnic Area  
GEOTECHNICAL REPORT

1. INTRODUCTION. This report addresses the geology, soils, and materials aspects of the project. It describes the geology and field investigations, and presents the results of subsurface explorations conducted to establish soil types and conditions in the area of the proposed recreation development. The location of the project is in the Tucson detention basin. The development will consist of a low-flow channel, a nature area, various playing fields, picnic areas, and restrooms. The development will also include the construction of access and service roads and parking areas.

2. TOPOGRAPHY AND GENERAL GEOLOGY. The detention basin of the Tucson Diversion Channel is located in the southern portion of Tucson, Arizona. It lies within the Santa Cruz River drainage area. The topography is generally flat within the boundaries of a 20-foot wide berm around the perimeter of the basin. Shallow rooted scrub growth, approximately 6 feet high, covers the northern one third of the basin floor and a 10-foot deep borrow pit has been excavated in the northeast corner near the inlet. The remainder of the basin floor is essentially level and free of vegetation. The geologic features in the project area are described in detail in the District Engineer's Interim Survey Report and the District Engineer's Review Report.

3. FIELD INVESTIGATIONS. A subsurface exploration at the project site was conducted during June 1977 to determine the character and extent of materials to be excavated in construction, to evaluate the foundation conditions for the proposed structures, to observe the nature of in-situ soils, and to determine earthwork construction techniques and material disposition. Ten test holes, TH 77-1 through TH 77-10, were drilled using a power auger with a 16-inch diameter bucket, to depths of 30 feet. Standard penetration tests were conducted in each test hole. In these tests, a 140-pound hammer, with a 30-inch free fall, was used to drive a standard sampling spoon having an outside diameter of 2 inches and an inside diameter of 1-3/8 inches. A record was made of the number of blows, N, required to advance the sampler one foot after the spoon was seated 6 inches into the bottom of the hole. The locations of the test holes are shown on plate 1. The materials encountered were visually classified and disturbed samples of representative materials were obtained for laboratory tests.

4. LABORATORY TESTS. Laboratory tests were conducted on disturbed samples obtained from field explorations. The tests consisted of mechanical analysis, Atterberg limits, moisture content determinations, and impact compaction tests conducted in accordance with EM 1110-2-1906. The soils were classified in accordance with the Unified Soil Classification System. Results of tests are presented in the logs of test holes shown on plate 2.

5. FOUNDATION CONDITIONS. The materials consist predominantly of clayey sands with minor occurrences of sandy clays and borderline sands. Moisture contents averaged 10 percent and ranged from 3 to 19 percent. Plasticity indexes ranged upwards to 28 percent. The standard penetration tests revealed the sand materials to have relative densities ranging from medium dense to



very dense and clay materials to have consistencies ranging from stiff to hard. In the southern half of the basin the materials are slightly to moderately cemented by caliche. Groundwater was not encountered during the exploration.

## 6. DESIGN VALUES

a. Unit Weights. The values in table 1 were selected for design. They are based on results of classification tests, compaction studies, and density tests conducted for this project; and detailed laboratory tests conducted for other projects using similar materials.

TABLE 1  
Unit Weights and Friction Angles

	Unit Weights (pcf)		Internal Friction Angle (deg)
	Dry	Drained	
Compacted Fills	110	125	30
Foundation	110	125	30

b. Balance Factors. For earthwork or material distribution computations, a balance factor of 0.85 would be used when converting bulk volumes into compacted volumes. The factor would apply to all areas of the project and would take into account loss of material during handling.

### c. Vehicular Pavement Design Values.

(1) Design values. Based on test results on similar materials (clayey gravelly sands and clayey sands) a CBR value of 11 is adopted for the native subgrade or fill from required excavation compacted to 95 percent of maximum density (ASTM D 1557). A CBR value of 80 is adopted for the aggregate base course.

(2) Design criteria. The flexible pavement for the access roads, parking areas, and paved trail/service road is designed in accordance with the Department of the Army TM 5-822-5. These pavements must be able to accommodate vehicles such as garbage trucks and maintenance vehicles at frequent intervals. The following values are adopted for design of pavements.

(i) Access roads. Class E road, traffic category II, design index 2.

(ii) Parking areas. Class E road, traffic category I, design index 1.

(iii) Paved trail/service road. Class E road, traffic category I, design index 1.

## 7. DESIGN APPLICATION

a. Excavation. Excavation can be accomplished by conventional equipment. Permanent excavation slopes of 1V to 3H would be stable. Temporary cut slopes shall be no steeper than 1V to 0.75H.

b. Foundation Preparation. Foundation preparation for embankments shall consist of grubbing and stripping to a depth sufficient to remove all vegetation and road fill material estimated to be 24 inches.

c. Foundation Design. Based on the results of the subsurface explorations and laboratory tests, the proposed structures may be adequately supported on continuous footings or thickened-edge slab-type foundations placed on undisturbed native materials or compacted fill. The allowable soil bearing capacity would be 1500 psf for footings based at a minimum depth of 12 inches below finished grade. The finished floor elevation of the structures shall be at least 6 inches above the surrounding grade. A vapor or capillary water barrier would not be required beneath slabs. All structural fills and backfills will be compacted to at least 95 percent of maximum density (ASTM D 1557) for a minimum depth of 3 feet below footings and within an area 5 feet outside of structures. Other fills are considered non-structural and will be compacted to 90 percent of maximum density (ASTM D 1557).

d. Embankments. The low-flow channel would be completely entrenched along the alignment and the embankments will be constructed of materials obtained from required excavations and consist of cohesive soils. Fills will be compacted to at least 90 percent of maximum density (ASTM D 1557). Permanent slopes will be 1V to 3H including areas where protective stonework is placed.

e. Vehicular Pavement Design.

(1) Pavement sections. The pavement sections required to satisfy the CBR and depth of compaction requirements are as follows:

(i) Access roads. The structural section will consist of 1-1/2 inches asphalt concrete, 5 inches of aggregate base course compacted to 100 percent of maximum density over 6 inches of subgrade compacted to 95 percent of maximum density (ASTM D 1557).

(ii) Parking areas. The structural section will consist of 1-1/2 inches asphalt concrete, 4 inches of aggregate base course compacted to 100 percent of maximum density over 6 inches of subgrade compacted to 95 percent of maximum density (ASTM D 1557).

(iii) Paved trail/service road. The structural section will consist of 1-1/2 inch asphalt concrete, 4 inches of aggregate base course compacted to 100 percent of maximum density over 6 inches of subgrade compacted to 95 percent of maximum density (ASTM D 1557).

(iv) All the pavement sections will be built-up at least 6 inches above the surrounding grade in order to provide adequate drainage of the pavement section.

8. SLOPE STABILITY. The embankments would have a maximum height of about 3 feet. The maximum slope would be 1V on 3H. Because flows are of short duration, the influence of seepage into the embankments and foundation would

AD-A136 927

TUCSON DIVERSION CHANNEL PHASE I SPORT FIELDS & PICNIC  
AREA FEATURE DESIGN MEMORANDUM NUMBER 3(U) ARMY  
ENGINEER DISTRICT LOS ANGELES CA APR 83

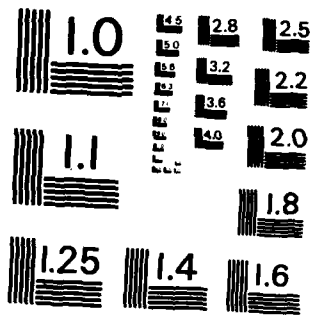
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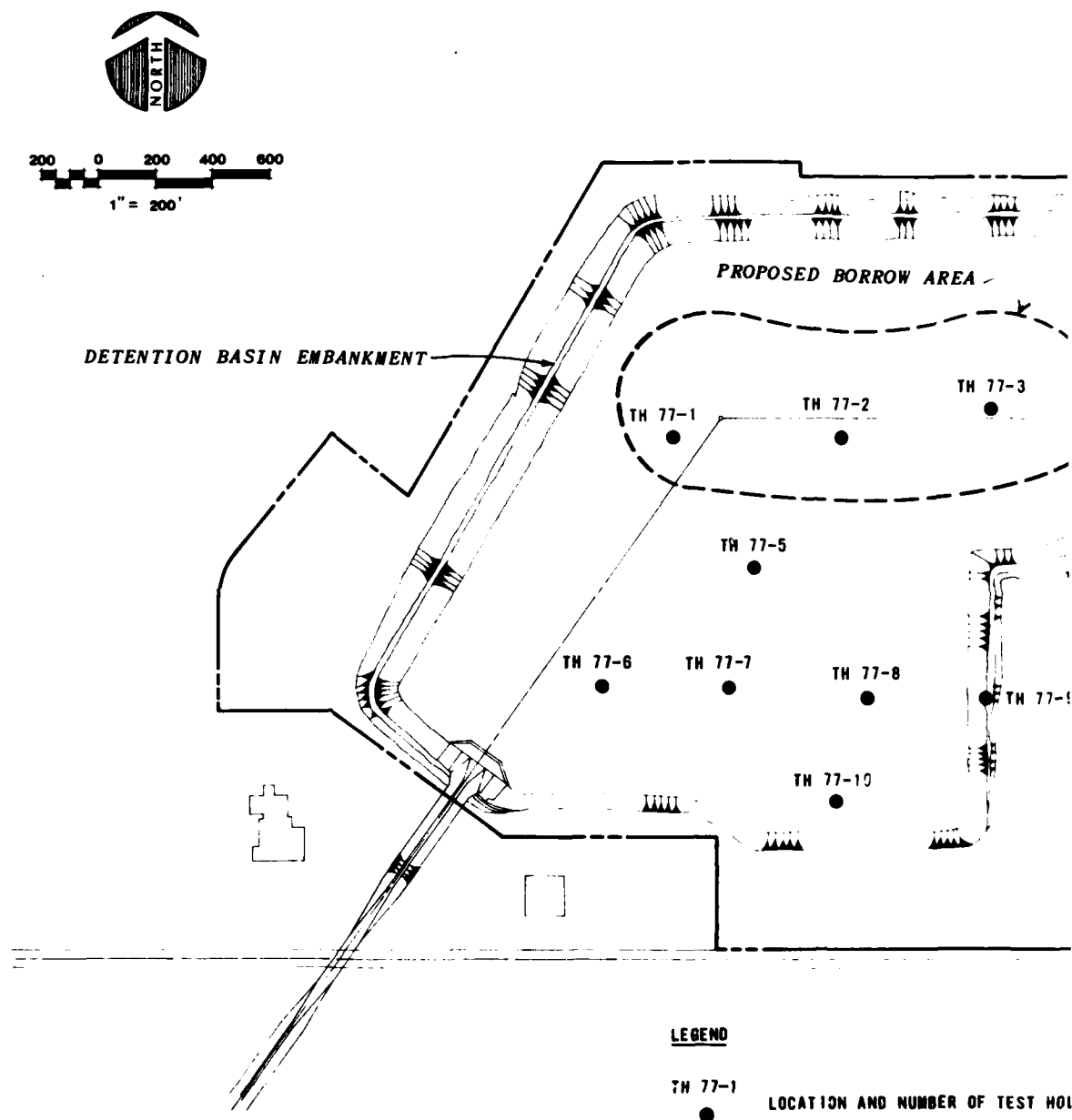


MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS - 1963-A

be negligible. Therefore, stability analyses were conducted using drained strengths. The safety factor determined using the infinite slope method of analysis is 1.73.

9. STONework. Grouted stone would be required for protection of the inlet portions of embankment. The stone used would be rounded, sound, hard, free from laminations, weak cleavages, undesirable weathering, and of such character that it would not disintegrate from the action of air, water, or from handling and placing. The minimum specific gravity will be 2.65 and the maximum percentage loss after 1,000 revolutions of the Los Angeles Abrasion (Rattler) Test will be 50. The minimum thickness required will be 15 inches thick and the stone gradation will be well-graded between 6 and 12 inches.

10. MATERIALS SOURCES. Ample quantities of construction materials would be available from excavated materials at the project site and from commercial plants. The location of the proposed borrow area is presented on plate 1.

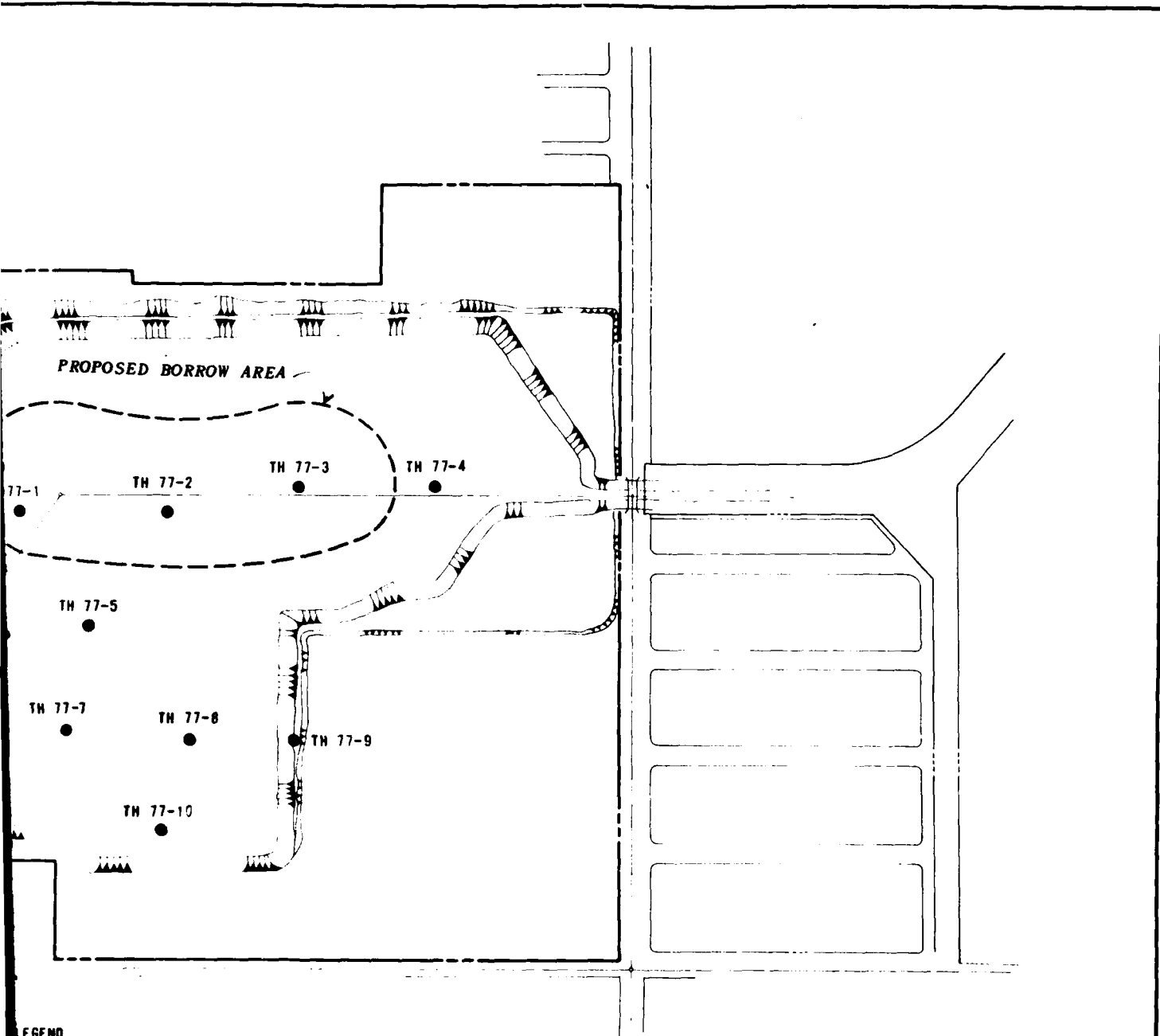


**LEGEND**

TH 77-1  
● LOCATION AND NUMBER OF TEST HOLE

**NOTES**

1. TEST HOLES WERE DRILLED DURING JUNE 1  
DIAMETER BUCKET TYPE POWER AUGER.
2. FOR LOGS OF TEST HOLES SEE PLATE 2.



DESIGNED BY		CHECKED BY		DATE		APPROVED	
DRAWN BY		REVISIONS		DATE		APPROVED	
LHR		U. S. ARMY ENGINEER DISTRICT TUCSON CORPS OF ENGINEERS		DATE		APPROVED	
TUCSON DIVERSION CHANNEL DETENTION BASIN PARK TEST HOLE LOCATIONS		DESIGNED BY		CHECKED BY		DATE	
APPROVED		SPEC. NO. 3420-01		DATE		APPROVED	
RECOMMENDED		DATE		DATE		APPROVED	

2  
**PLATE C-1**

MC LL, PI - 4-200 M		
30'	BC 7 32 14 94 37	CLAYEY SAND, tan, gravel pos-sized to 1", very dense to dense
		46
		20
	CL 12 26 11 99 36	SANDY CLAY, brown, 1" max gravel, very stiff to hard
7.5'		37
		52
	BC 11 26 12 100 36	CLAYEY SAND, brown, dense
12.0'		34
		27
	20 35 16 100 77	SANDY CLAY, brown, very stiff
		18
	CL	24
	20 32 16 100 66	22
19.5'		20
	BC 13 25 10 98 56	CLAYEY SAND, red-brown, pos-sized gravel, med dense
22.5'		25
	6 NP NP 98 11	SAND-SILTY SAND, brown, dense
25.5'		43
		45
	3 NP NP 91 7	pos-sized gravel, dense to very dense
		56
30.0'		104

MC LL PI - 4-2004					
	10	40	17	300 75	
					3
	B	35	17	300 58	27
					31
CL	15	32	14	300 60	27
					21
					17
	B	32	13	300 80	31
					41
13.5'					40
BM	11	20	7	97 37	46
					44
18.0'					35
	SC	11	25	9 300 43	33
					36
22.5'					31
	CL	20	31	13 300 74	41
					34
25.5'					31
BM	13	26	6	300 48	27
					28
30.0'					21

SANDY CLAY, tan to brown, med to hard

SILTY SAND-CLAYEY SAND, red brown, dense

CLAYEY SAND, red brown, dense

SANDY CLAY, brown, hard

SILTY SAND-CLAYEY SAND, red brown, med to dense

MC, LI, P, 4-200 N		
30'	BC 6 27 10 88 35 17	CLAYEY SAND, tan, 2" max gravel, dense
		45
60'	BC 7 NP NP 97 35 29	SILTY SAND, brown, 2" max gravel, med dense
		21
		33
		22
	CL 11 24 9 100 56	SANDY CLAY, brown, 1" max gravel, very stiff
		30
20'		22
		22
		24
	SC 10 24 11 95 40	CLAYEY SAND, brown, 1" max gravel, med dense
		27
65'		27
		28
	11 29 11 100 60	SANDY CLAY, brown, gravel pebbles to 1" max, difficult dredging below 20', very stiff to hard
		30
	CL 12 30 14 100 63	
		46
240'		30
		30
	SC 9 37 19 94 36	CLAYEY SAND, tan brown, 2" max gravel, very dense
		30
100'	12 37 15 97 46	

MC L L, 4-200 N		
6	24 9 94 52	CLAYEY SAND, tan, 1" max gravel, very dense
7	33 14 94 34	
6	29 14 95 34	
4	25 10 79 16	CLAYEY GRAVELLY SAND, tan, 3" max gravel, very dense
MC	- - - -	
4	26 10 82 17	2" max gravel
4	26 10 84 21	
5	39 20 86 12	CLAYEY SAND, tan, 2" max gravel, very difficult drilling at 23-24', very dense
4	26 8 86 20	3" max gravel, difficult drilling

MC 11, 400 ft.

45'	BC	3	37	17	83	17	43	20	GRAVELLY CLAYEY SAND, 1in. 2" max gravel, med dense to dense
							51		
	BC	6	34	18	77	17	80	20	GRAVELLY SAND-CLAYEY GRAVELLY SAND; red-brown, 2" max gravel, very dense
90'							80		
	BC	12	38	18	92	33	37	20	CLAYEY SAND, red-brown, 2" max gravel, very dense
135'							47		
	BC	6	27	3	86	9	47	20	SAND-SILTY SAND; tan, 1" max gravel, dense
	BC	7	NP	NP	86	11	38	20	
195'							41		
	BC	10	32	15	94	23	20	20	CLAYEY SAND; tan, 1" max gravel, very dense
							20		
	BC	13	41	19	80	27	20	20	
							20		
300'							20		
	BC	16	48	18	100	28	20	20	

15'	MC LL PL 4 200 4				
	6	32	15	100	99
					14
	12	40	21	100	40
					16
					32
	17	49	27	32	20
					34
					27
					32
	7	31	17	100	40
					39
					37
					32
	17	32	15	100	40
					42
					46
	13	37	20	100	40
					33
					15
	15	30	18	90	40
					20
					13
270'	19	33	18	97	32
					28
	18	NP	NP	90	2
					50
300'					46

SANDY CLAY, white-tan, moderately cemented by caliche, very stiff

CLAYEY SAND, light brown to brown, moderately to slightly cemented by caliche, pastured gravel, mud dense to dense

very little caliche below 21'

SILTY SAND, brown, dense to very dense

MC LL PI 4-200 N

9	20	13	100	43
12	26	12	64	18
11	40	19	100	40
10	40	17	100	38
11	31	13	100	32
13	34	15	90	30
14	42	18	100	27
17	41	16	80	24

CLAYEY SAND, light brown, slightly cemented by caliche, very dense

CLAYEY GRAVELLY SAND, light brown, moderately cemented by caliche, dense to very dense

CLAYEY SAND, light brown, moderately cemented by caliche, med dense to very dense

red-brown

brown with white caliche

300

	MC	LL	PI	-4	200	N	
30'	MC	6	29	11	90	32	CLAYEY SAND, tan, 1" max gravel, slightly cemented by calcite, very dense
		6	19	10	82	29	GRAVELLY SILTY SAND, tan, 2" max gravel, moderately cemented by calcite, difficult drilling from 7.5-10.5', very dense
105'	SM	8	46	18	97	18	
		9	44	26	97	32	CLAYEY SAND, light brown to red-brown, slightly cemented by calcite, dense to very dense
		7	31	17	92	21	
	DC	6	27	14	96	23	
		10	44	27	98	34	
205'		4	30	15	90	12	SAND-CLAYEY SAND, red-brown, very dense
300'	MC						

MC	LL	PI	4	200	N
	10	35	13	93	42
	14	42	17	89	30
	14	38	21	97	51
	11	37	18	75	17
	12	29	15	89	34
	13	39	19	95	32
	15	39	20	98	34

CLAYEY SAND, tan, 1" max gravel, very dense

red-brown, pea-sized gravel, slightly cemented by calcite

CLAYEY GRAVELLY SAND, brown, 2" max gravel, some 4" cobbles, very dense

CLAYEY SAND, brown, 2" max gravel, moderately cemented by calcite, very dense

Pea-sized gravel

VERT SCALE 9 10 15  
10 FEET



### UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		GROUP SYMBOLS		TYPICAL NAMES	
COARSE GRAINED SOILS More than half of material is larger than No. 200 sieve (4.75 mm).	GRAVELS More than half of coarsest fraction is greater than No. 10 sieve (2.0 mm) and less than No. 4 sieve (4.75 mm).	Clay with sand	GW	Well-graded gravel, gravel-sand mixtures, little or no fines.	
			GP	Poorly-graded gravel, gravel-sand mixtures, little or no fines.	
			GM	Silty gravel, gravel-sand-silt mixtures.	
	SANDS More than half of coarsest fraction is greater than No. 4 sieve (4.75 mm) and less than No. 10 sieve (2.0 mm).	Clay with sand	GC	Clayey gravel, gravel-sand-silt mixtures.	
			SW	Well-graded sand, gravelly sand, little or no fines.	
			SP	Poorly-graded sand, gravelly sand, little or no fines.	
FINE GRAINED SOILS More than half of material is smaller than No. 200 sieve (4.75 mm).	SILTS AND CLAYS	Sand with fines	SM	Silty sand, sand-silt mixtures.	
			SC	Clayey sand, sand-silt mixtures.	
			Low liquid limit	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sand, or clayey silt, with slight plasticity.
		CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	
		OL		Organic silts and organic silty clays of low plasticity.	
		High liquid limit	MH	Inorganic silts, micaceous or silty clays of low plasticity.	
CH	Inorganic clays of high plasticity, fat clays.				
OH	Organic clays of medium to high plasticity, organic silts.				
Highly organic soils		PT	Peat and other highly organic soils.		

**NOTES:**

- NOTE: 1. Boundary Classification: Sells possessing characteristics of two groups are designated by combinations of group symbols. For example, GW-AC, well-graded gravel-sand mixture with clay binder.
2. All sizes shown on this chart are U. S. Standard.
3. The terms "all" and "clay" are used respectively to distinguish materials exhibiting lower plasticity from those with higher plasticity. The minus no. 200 size material is all if the liquid limit and plasticity index plot below the "A" line on the plasticity chart (Table IV, Testory Standard 6190) and is clay if the liquid limit and plasticity index plot above the "A" line on the chart.
4. For a complete description of the United Soil Classification System, see the "Military Standard 6190" dated 20 March 1976

TH 77-6

	MC LL PI: 4-200 N	
15	CL 6 32 15 800 59 24	SANDY CLAY, white-tan, moderately
	14	contaminated by caliche, very stiff
	12 40 21 800 40 20	CLAYEY SAND, light brown to brown,
	16	moderately to slightly contaminated by
	32	caliche, medium-sized gravel, med
	17 49 27 92 26 34	dense to dense
	27	
	32	
	7 31 17 800 40 39	
	37	
	17 32 15 100 40 32	
	42	
	46	
	13 37 20 800 45 33	
	25	very little caliche below 2'
	15 34 18 98 42 20	
	13	
270	19 33 18 97 32 26	
	50	
300	18 NP NP DO 21 44	SILTY SAND, brown, dense to very
		dense

Y H 77-7

MC LL PI - 4 200 M

Depth (ft)	Depth (m)	Notes
60	18.3	CL
45	13.7	CL
30	9.1	CL
27	8.2	CL
24	7.3	CL
21	6.4	CL
18	5.5	CL
15	4.6	CL
12	3.7	CL
9	2.7	CL
6	1.8	CL
3	0.9	CL
0	0.0	CL
60	18.3	MC
45	13.7	MC
30	9.1	MC
27	8.2	MC
24	7.3	MC
21	6.4	MC
18	5.5	MC
15	4.6	MC
12	3.7	MC
9	2.7	MC
6	1.8	MC
3	0.9	MC
0	0.0	MC
60	18.3	30'
45	13.7	30'
30	9.1	30'
27	8.2	30'
24	7.3	30'
21	6.4	30'
18	5.5	30'
15	4.6	30'
12	3.7	30'
9	2.7	30'
6	1.8	30'
3	0.9	30'
0	0.0	30'

SANDY CLAY, brown, pea-sized gravel, slightly cemented by calcite, hard drilling below 15', hard

CLAYEY SAND, red-brown, slightly to moderately cemented by calcite, very dense to med dense

2" max gravel

1" max. gravel

very difficult drilling below 27'

### LEGEND

- |       |  |
|-------|--|
| T. N. |  |
| 0     | LOCATION AND NUMBER OF TEST HOLE.  |
| M 0   | FIELD MEASURED CONTENT IN PERCENT OF DRY WEIGHT.   |
| L 1   | LIQUID LIMIT.  |
| P 1   | PLASTICITY INDEX (LIQUID LIMIT MINUS PLASTIC LIMIT).   |
| M P   | MECHANISTIC.   |
| - 0   | PERCENT OF MATERIAL BY WEIGHT PASSING NO. 4 SIEVE.   |
| - 200 | PERCENT OF MATERIAL BY WEIGHT PASSING NO. 200 SIEVE.   |
| N     | NUMBER OF SLIPS OF A 145-POUND SHEARSTRESS BALLSAS<br>TESTER USED TO DETERMINE SHEAR STRESS FROM<br>CUT. OUTSIDE DIAMETER OF SPIN IS 2 INCHES;<br>INSIDE DIAMETER IS 1-3/8 INCHES. PROCEDURE IS<br>CALLED STANDARD PENETRATION TEST. |
| W     | SOIL TO WATER.   |

T. H. 77-10

MC	LL	PI	#	200	MC	LL	PI	#	200	MC	LL	PI	#	200
				89					89					89
	10	35	15	93					42					42
	4	42	17	89					30					30
	14	38	21	97					31					31
	11	37	18	75					17					17
MC									80					80
	12	29	15	99					34					34
									80					80
	15	39	19	95					32					32
									80					80
	15	39	20	98					34					34

PROJECT <input type="text"/>		REVISIONS <input type="text"/>		DATE <input type="text"/>		APPROVAL <input type="text"/>	
REVISIONS				U. S. ARMY ENGINEER DISTRICT 100 CENTER CORPUS OF ENGINEERS			
DESIGNED BY <input type="text"/>		GILA RIVER AND TRIBUTARIES ARIZONA AND NEW MEXICO					
DRAWN BY <input type="text"/>		TUSCON DIVERSION CHANNEL DETENTION BASIN PARK					
CHECKED BY <input type="text"/>		LOGS OF EXPLORATION					
SUBMITTED BY <input type="text"/>		APPROVAL <input type="text"/>				DATE <input type="text"/>	
APPROVAL <input type="text"/>		SPEC. NO. <input type="text"/>				DATE <input type="text"/>	

**PLATE C-2**

2

DATE  
LMED  
8